BUILDING
THE HOUSE OF HEALTH
A MODERN HOME

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THE PRACTICAL BOOK OF
BUILDING
"THE HOUSE OF HEALTH"
(2nd Edition)

By ODD ALBERT, C.E. and M.S., Prof. Engineer

Associate Member of the American Society of Civil Engineers, Member of American Concrete Institute, formerly Faculty Lecturer on Advanced Design of Structures at New York University, with the co-operation of prominent architects and research departments of great trade associations.

A Handbook for every homeowner or prospective homeowner. How to finance, what to build, how to equip, to make the least amount of capital buy the most.

GARDEN CITY PUBLISHING COMPANY, INC.
GARDEN CITY NEW YORK

DEDICATION

To the President
and
Mrs. Franklin Delano Roosevelt

Whose tireless striving has made so heavy a contribution to the better housing of the American people, and to whose intelligent and forceful support we owe so large a measure of the success of the movement for better living conditions, this book is respectfully dedicated.

PUBLISHER'S PREFACE

● EVERY HOMEOWNER plans to build again someday. Every tenant looks forward to the day when he may cease paying rent and own his home, and all of us are interested—even fascinated—by new designs, labor-saving equipment and the practical sturdy construction of the really modern home.

Most of us can read floor plans but few laymen have any useful idea of construction. Should we build a frame house, or concrete, or brick? What is the advantage or disadvantage in solid brick vs. veneer? Is steel really better than wood? Is insulating worth while? Which type is best? What about flooring, and what should we use for roofing? Why? How about plumbing? Wiring? How should we heat our house—coal? oil? Should we have steam? Hot water? Vapor? What about air conditioning? To answer these and a hundred other questions we must have *facts!*

Then there is the question of how and where we can get the money. How much will it cost us to borrow? Should we have an architect? What should he do for us? What can we expect of our contractor? How can we tell whether he is overcharging us and what have we a right to ask him to do? The answers to these problems again require facts—facts from a hundred different sources.

The purpose of this booklet is to gather these facts into one volume to give answers to these vital questions, to let the homeowner know what he should ask for and what he is getting—to make sensible suggestions and warn him off the path that leads to pitfalls of unnecessary expense—in short, to take the mystery out of "plans and specifications."

When we put even as little as $4,000 into a home we should know how best to spend it. We should buy building at an investment, with minimum cost, and maximum return in health and happiness over a long period.

Having these ideas in mind, Mr. Odd Albert has done a real service in editing this book. In addition to giving you the general information you need to build sensibly, he gives names so that you may know you are getting what an experienced engineer considers the best, and not the second best, in material and service.

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How This Book Will Help You Build the BEST HOME for Your MONEY

● THIS BOOK will help you in selecting the proper methods for constructing a permanent attractive home. It contains data on old and familiar types of construction, as well as on the new developments in the field. The "House of Health" will embody many of the recently introduced methods of construction for which the qualifications are that they be efficient and technically sound.

The information and suggestions offered, if followed by you, will relieve you of a great deal of the common houseowner's annoyances and avoid a great many possible regrets.

BASIC RULES FOR THE PROSPECTIVE HOME BUILDER

We start with a word of caution, because we know you want to be certain that the ownership of your home after you have built it will not prove a burden to you. Here is a plan that will practically remove all of the heartaches from home ownership.

Do not try to build a house unless you have sufficient cash to cover the cost of your lot, plus one-fifth of the cost of the home you plan to build. If you are buying a home, make sure that its total price does not exceed four times your annual income, exclusive of the price of the lot.

If, as we hope, you now own your lot free and clear, the situation is somewhat different, and the ready cash necessary to build the "House of Health" need only be the equivalent of one year's income. For the average ordinary dwelling the customary ratio under these circumstances for the cost of the house is that it should not cost more than three times the amount of the annual income. The "House of Health", however, because of its good design and permanence, may be sensibly purchased at this higher figure of four times the annual income. Once the cost of your house is established, there are several logical steps that should be followed for the thorough enjoyment of your home.

USE AN ARCHITECT

If you are building your own home, first employ a competent architect to design it. He will show you how to include the features you want to the best advantage and, at the same time, being thoroughly acquainted with all the recent developments in construction, will do the job, as an expert, far better than you could even visualize it. He may explain to you why some of your desires are not practical, or how the same objective can be obtained in a more modern and efficient manner.

It is this feature of expert architectural advice in every "House of Health", down to its smallest detail, that makes it a good buy no matter where and when it is built.

THE FINANCING

The proper financing of your house is very important. A scheme that will prove economical for one person may not prove to be the best one for you. There are several types of agencies to which you can apply: the bank, the building and loan association, the government, etc. Through a building and loan association, for instance, if you obtain a loan of $6000, you pay back 1 per cent, or $60, per month for 11¾ years, after which the house is fully paid for and is yours. The government is offering longer term loans—as described on the following pages—and with them, for instance, on this same loan of $6000 you can pay back approximately $40 a month over a period of 20 years and pay off your loan.

A straight mortgage with as low an interest as 4 per cent may also be obtained on the "House of Health." This low interest rate is not available on loans of all types of construction, but because of the superior methods used in the "House of Health" you may obtain the low rate.

FINANCING COMBINED WITH LIFE INSURANCE

The tragedy of a head of a family who dies after having built a home under one of the above methods of financing, after

ACKNOWLEDGMENT

The author takes advantage of this opportunity to express his deep appreciation to the architects and engineers mentioned below who have contributed so freely of their time and been so lavish in their counsel and co-operation.

Some of the architects were given certain ideas to work from, others were given complete freedom to create something new and different.

Will Rice Amon
Victor Civkin
Bradley Delehanty
Perry M. Duncan
F. E. Emery
Frank J. Forster
Thomas A. Greacen
J. H. Hansen
William F. Lockhardt
H. P. Merrick
C. George Segeler

only a few years of ownership, is common. The family income having stopped with his death, the house is lost. This can be avoided by coupling homeownership with a life-insurance policy covering the amount of the mortgage. Thus in case of death the mortgage is automatically paid up and the family owns the house free and clear. This is the type of protection that is open to builders of the "House of Health." The cost of combining the life-insurance premiums, interest and payment on the mortgage, to be paid up in 20 years, will be approximately ¾ per cent per month of the amount of the mortgage.

It is strange that this guarantee of family happiness has not been followed more generally in this country.

MAKE A FRIEND OF YOUR LOCAL REALTOR

A poor house can spoil a good neighborhood. Likewise, a poor neighborhood can spoil the value of a good house. Make sure that you know what your neighborhood will be before you build in it. The sales value of your house may suddenly become very important to you in the event circumstances are such that you will want to sell it. Your local realtor is an expert on the trends and developments of the various localities. Ask his opinion. Let him help you pick out your lot.

USE A REPUTABLE CONTRACTOR

No one can long afford to sell anything at less than it costs. A contractor cannot afford to sell a house for less than it costs him to build it, plus a legitimate profit. When you secure bids from or employ a contractor to build your house at a fixed price, do not press him too hard to reduce his price, because it is possible to reduce the price by substituting inferior materials. Instead, make a friend of him. Give him a square deal, and he will give you one. If, under pressure, he is forced to reduce his price he can, without you detecting it—unless you are an expert—put in a poor grade of lumber, a different type of piping, and innumerable other items which he knows about and you do not.

COMMON MISTAKES IN HOME BUILDING

The above suggestions will sound almost too elemental to need printing, and yet every day there are examples of how these suggestions are not followed, with consequent disappointments. There are many odds against the home builder. Hundreds of families lose their houses every year. One of the common reasons is that excessively large houses are bought merely because they seem to be a great bargain. Believing a house to be a bargain, it is purchased sometimes at a price greater than three times the buyer's income. Consequently, the financing is a burden. A very small down payment having been made, frequently as much as 10 per cent is paid out as an extra financing charge. The result is that carrying charges, which include the high interest and high upkeep, have frequently exceeded 25 per cent of such a buyer's income. Such a purchase, appearing to be a lot of house for the money, is frequently a lot of trouble for the money. It was cheap in price because the roof needed repairing, the cellar may have leaked, the heating system was old-fashioned and inadequate, wallpaper and paint needed replacing, and, consequently, the new owner lives in it very unhappily, because all of these repairs, not obvious in the first instance, cost a great deal of money, and the conveniences that only modern construction can furnish are missing. Excess space in old-fashioned hallways must be heated but never used. Petty annoyances pile up one onto the other, and in a few years, rather than continue the expensive repairs, he lets the house go for the mortgage.

THE "HOUSE OF HEALTH"

How different it is with the "House of Health." It is scientifically as well as artistically designed. The latest improvements in materials and construction are utilized. An alert architect is employed to design it for your own particular family habits of living. The expert realtor has chosen the location, and a reliable contractor puts it up, using the recommendations as embodied in the "House of Health" standards. It is priced to be consistent with your income and reduces, so far as is practical, all the upkeep and carrying charges and petty annoyances that tend to mar the happiness of the family living in it.

Indeed, it is not only the "House of Health" but a house for happiness, health and contentment.

PUBLISHER'S NOTE: If you have problems that are not sufficiently covered in this book you are privileged, as a purchaser thereof, to write directly to the author, Odd Albert, c/o Opla Company, Box 66, East Orange, N. J. He offers his services as a consultant engineer free of charge to you. He probably can assist you in estimating not only the total cost of your proposed house, but also what its probable running cost will be. He will give you advice about the architect, about the builder, various manufacturers of products, etc. Furthermore, within a reasonable radius of his office, Mr. Albert will, if you desire, undertake to build your house at a fixed price including everything. By building it to order, you will find the cost much lower than for a speculation-built house of the same size, where a big margin of profit is included to take care of builders, developers, salesmen, financing, advertising, etc.

INVESTORS OPPORTUNITY: Prospective investors might do well to note that here is a field for investment of money at a higher rate than is paid on ordinary bank deposits. First mortgages will be available to such investors upon completion of "Houses of Health."

How the Cost of a House Can Be Reduced

A house bought for cash will, of course, cost you much less than one bought on borrowed money. Unfortunately, however, many of us cannot buy a house in this manner, and must turn to mortgage and financing companies for assistance. The average person is more or less at sea when he starts to arrange such financing for his house, and this is where the speculative builder steps in.

The function of a speculative builder is to pay out either his own or borrowed money for the construction of a house which he in turn hopes to sell to you, or someone else. If he borrows the money to do this he must pay interest, and of course must charge you for that interest in addition to the cost of the house. If he uses his own money, he is entitled to interest also.

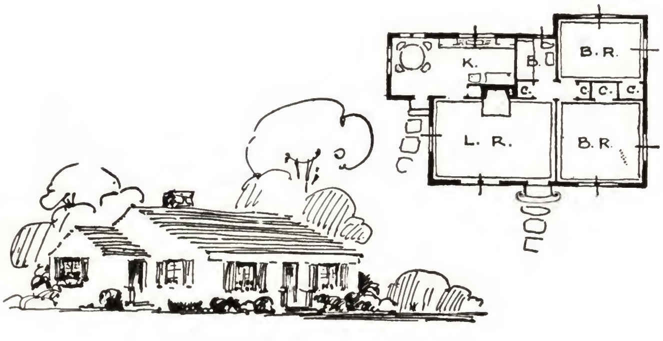
The speculative builder, operating as he does on a large number of houses at one time, and having as a rule purchased his land in large plots, can reduce the actual cost of construction considerably. On the other hand, he incurs expenses that the private builder does not. Building on speculation, he must advertise, and employ salesmen to sell his houses. These expenses reduce somewhat the savings he has made on construction costs by large-scale operation.

The intelligent use of a large operator of this type would be to have him build a house for you, to order. He would like nothing better, because he does not particularly like the risk involved in putting up a house and holding it until he sells it. If he has an order from you in advance, he does not have to advertise, or employ a salesman to sell the house, and immediately these rather high expenses are eliminated. He can then give you the benefit of his broad experience in large operations, and of course if you take care of all expenses as they occur with your money, you will not have to pay him interest for the use of his.

A Little Ideal "House of Health" for the "Old Folks" or the "Young Couple"

Here is shown a house that can be built for about $4,000. If you own your land, no cash is required in order to have this house built with small changes to suit your requirements.

The house is of best possible construction, with brick walls, masonry floors, it is insulated and has asbestos roofing shingles. There is air conditioning included as well as modern bathroom and kitchen.



The yearly charges are as follows:

Taxes, approx. 2½%	$90.00
Depreciation, ½%	20.00
Heating	50.00
Maintenance, ½%	20.00
Amortization, 8%	320.00
Yearly cost	$500.00

As the loan is amortized with 3%, or with $120:—, the actual cost will be only $380:—, or $31.70 per month. This is considerably less than rent.

The Actual Cost of More Expensive Construction

There is a great deal of discussion in construction circles at the present time of offering reduced interest rates on well-constructed houses. In the future many of these preferential rates will be well established. Even now, however, financial agencies recognize the value of good construction and will not only offer lower rates for the well-constructed house but will also increase the amount of the loan far above that available for the jerry-built house.

Therefore, if the cost of some items in the construction of your house is increased in order that better quality may result, it does not necessarily mean that there will be an increase in the actual cash that you will have to lay out for the house. For instance, suppose an additional $500 were added to your house to secure fireproof floors and walls. It will be easy, because of these features, to increase your mortgage by this $500. The monthly payments on the mortgage will consequently be increased. This increase, however, is very small. The following table is presented in order that you may see at a glance the increases in your monthly payments on each increase of $100 on your mortgage. The table includes interest rates of 5% and 6% and for 12 and 20 year amortization periods—that is, the period over which you will make monthly payments. Thus, as the table indicates, for improvements costing you $500 extra, the increase in your monthly payments will only be $3.34 if your mortgage runs for 20 years at 5% compound interest.

Increases in dollars in the monthly payments on the mortgage for given increases in the mortgage. Time for the amortization is either 12 or 20 years, and the interest is compounded annually.

	Time of amortization			
Increase in	12 years		20 years	
Mortgage of	5%	6%	5%	6%
$100	$0.94	$0.99	$0.67	$0.73
200	1.88	1.99	1.34	1.45
300	2.82	2.98	2.01	2.18
400	3.76	3.98	2.68	2.90
500	4.70	4.97	3.34	3.63
600	5.64	5.96	4.01	4.36
700	6.58	6.95	4.69	5.08
800	7.52	7.96	5.36	5.81
900	8.46	8.94	6.03	6.5
1000	9.40	9.94	6.70	7.27

The GOVERNMENT MORTGAGE PLAN for Residential Construction

By ARTHUR WALSH

Assistant Federal Housing Administrator

● THE NATIONAL HOUSING ACT was passed by the 73rd Congress and signed by the President on June 27, 1934. This legislation provided for the creation of the Federal Housing Administration with two primary functions of home financing—the Modernization Credit Plan and the Insured Mortgage System, including a method of insuring large-scale housing projects.

The Modernization Credit Plan was embraced in Title I of the National Housing Act. This provided for the insurance, by the Federal Housing Administration, of private financial institutions against loss on loans made for the purpose of making additions, alterations or repairs to property. In its initial form, the maximum of such loans was set at $2,000 on dwelling properties but was later amended to make government insurance applicable to loans up to $50,000 on multiple family dwellings, apartment buildings, hotels, schools, colleges, orphanages, business and industrial plants. A still later amendment made such loans insurable under the Act for church modernization.

The sweeping intent of the Modernization Credit Plan was to open channels of consumer credit to property owners, so that they might obtain funds with which to improve their holdings, and at the same time stimulate the employment of thousands of artisans and skilled workers in the construction industry and thereby promote general recovery. Under this plan the borrower may obtain an insured loan from a private financial institution repayable in periods up to three years. In some cases five years is allowed. Repayment is required in equal monthly installments. Interest and other charges cannot exceed an amount equivalent to a $5 discount per $100 face value of a one-year monthly installment note.

The Modernization Credit Plan has undergone several changes in form since its inception, particularly as to the eligibility for insurance of notes covering equipment and machinery. Originally, insurance applied only to loans for specific structural additions, alterations and repair and to equipment and machinery that was "permanently attached" to the plumbing, heating, wiring or other structural components of the home. This was later amended so that such equipment and machinery "need no longer be attached." Still later, the original regulation was reapplied to loans of $2,000 or under, while the more liberal interpretation remained for loans above $2,000.

Under the plan allowing for modernization loans in amounts above $2,000 and up to $5,000, the plan was also amended to some extent. In such cases, because of the larger loans involved, the administrator deemed it appropriate that lending institutions accept collateral, while not making it obligatory. In the case of these larger loans, as in granting those under $2,000, the determination of interest rate within the maximum is left entirely to the borrower and lender.

ARTHUR WALSH

Mr. Arthur Walsh was first deputy regional director of Region No. 3, including New Jersey, Delaware, and Pennsylvania, under Charles Edison. He succeeded Mr. Edison as regional director last November and came to Washington last June as deputy administrator in charge of Title I.

He was an intimate associate of the late Thomas A. Edison and has been closely associated with Charles Edison in business, being vice-president and a member of the Board of Directors of Thomas A. Edison Industries Incorporated, vice-president of Edison Pioneers, and a member of the International Edison Foundation. He was educated at the New York University School of Commerce, served as a lieutenant in the United States Navy, is a member of the Workmen's Compensation Commission of New Jersey, the Regional Plan Association, and the Board of Directors of the First National Bank of Orange, New Jersey.

THE INSURED MORTGAGE SYSTEM AND ITS OPERATION

The provisions of Title II of the National Housing Act created a mutual mortgage insurance system whereby private financial institutions are empowered to lend money on insured home mortgages up to 80% of the appraised value of the property. The land may be accepted under certain circumstances as the 20% equity. This type of mortgage was without precedence in the home-mortgage history of the nation. Its operation was temporarily arrested by the necessity for the passage of acts by the various state legislatures enabling their state institutions to take advantage of it. Previously, there were statutory limitations in the various states which forbade the lending of money on mortgages in excess of 60% of the valuation of the property. In all of the states, with one or two exceptions, legislation was enacted which enabled the financial institutions of the states to take full advantage of the National Housing Act and the plan of the Federal Housing Administration and lend money upon 80% of the appraised valuation. The new legislation in the states also made it legal for insured mortgages and debentures issued against them to be accepted as collateral for the deposit of state funds.

It was not until the spring of 1935 that the Insured Mortgage System of the FHA became fully operative. From that time, however, it made great progress. As of November 14, 1936, the Federal Housing Administration has accepted for insurance 136,678 mortgages totaling $547,439,493—which represents approximately a year and a half of operation. It is significant that during the three months of July, August and September, 53% of the mortgages accepted for insurance by the Housing Administration were for new home construction. The total "mortgages accepted" figure, however, includes purchase money mortgages and refinanced mortgages.

The Insured Mortgage System was created primarily as a method whereby a large majority of American families might obtain a form of home financing within their means. It also eliminated the necessity for obtaining short-term mortgages, mortgages subject to call, and the frequently usurious second and third mortgages. Under the Insured Mortgage System, as stated before, the borrower may obtain financing up to 80% of the appraised value of the house and lot and repay the obligation in equal monthly installments. These installments, moreover, are fully amortized, which means that with every monthly payment the borrower is retiring a part of the principal of his loan. These payments also include interest, as well as annual taxes and hazard and fire insurance.

The insured mortgage may be written so as to cover a period up to 20 years and the interest rate cannot exceed 5% plus ½ of 1% as a service charge and ½ of 1% for mortgage insurance. This interest rate is not arbitrary and may be less than 5% at the option of the lending institution. The Federal Housing Administration appraisal fee of $3.00 per thousand, with a minimum of $10, is required.

Under this form of financing, a prospective homeowner may purchase his home under a plan whereby his monthly payments in many cases amount to no more than the payment of rent for a similar property. When the last payment is made, the debt is liquidated, and the owner becomes an owner in fact, with his property freed from obligations. Throughout the period during which the loan runs, he makes his payments on a convenient monthly basis suited to his income.

MODERN HOMES
for Moderate Incomes

By THOMAS G. GRACE

New York State Director, Federal Housing Administration

Osborne home at Suffern, N. Y., built through a Federal Housing Administration insured mortgage.

● THE INITIAL APPROACH to home-owning is apt to be accompanied by varying emotions. This is particularly true of a nation of rent payers. Ownership of land is not as widespread in the United States as in some other countries, because our population is largely massed in cities, the residents of which are, in the main, the tenants of landowners. Decentralization of these congested areas can best be accomplished through home-owning. In some countries in Europe this has been successfully worked out; in others, the solution of the problem still is in the experimental stage.

Home-owning in the United States for people of moderate means involves a complete metamorphosis of view point. The generations ahead of us paid rent; we pay rent and have never seriously considered any alternative. So if our approach to home-owning is a little timid there is ample reason for it. It involves new thinking and some of us are just a little bit frightened at the idea of assuming obligations that are strange to us.

When Congress passed the National Housing Act it had a number of objectives in view. Most of these have been successfully carried out. The biggest problem of all was a mortgage system under which home-owning would be made possible for the small wage earner, and that is the task to which the Federal Housing Administration set itself.

With the average American, rent represents the maximum monthly payment out of income that he can make. Therefore, if rent payers are to be converted into homeowners it must be on terms that do not exceed normal rentals. This has been accomplished. In this country today homes have been acquired by thousands of people who had never considered such a thing as within their grasp a few years ago. These they are paying for, over twenty-year periods, at what approximates rent levels. When the obligation that they have assumed has been amortized they have to show for their effort a home free of all encumbrance instead of a mere file of rent receipts.

It is no part of the government program to induce people to assume obligations which they cannot meet. One's future must be fairly well secured if he is to enter into a home-owning enterprise. However, the average man is just as well able to pay off a monthly part of his mortgage as he is to pay rent, and every time he makes such a payment he is increasing his personal equity in the property involved, which is not the case when he is merely leasing the premises.

Under the Insured Mortgage System of the Federal Housing Administration the government lends no money. Its contribution to all transactions is 100% insurance of the lending institution against loss in case of default. This insurance, however, is contingent on certain regulations largely drawn for the protection of the home buyer. So when you enter into a contract to purchase a home, the mortgage on which has been insured by the government, you may be certain that it is constructed of the best and most lasting materials, that it is properly located, and that it conforms to the most modern in architectural design and in resistance to the hazards of fire and weather.

THOMAS G. GRACE

Thomas G. Grace, New York State Director of the Federal Housing Administration, was born in Brooklyn in 1895, educated at the New Utrecht High School, Colby College and St. Lawrence University and admitted to the bar in 1925. He was instructor of physics and biology at New Utrecht High School, professor of Law of Trusts and Partnership at St. Lawrence University, and former president of the New York Colby Alumni Association.

Mr. Grace is a veteran of the World War, having enlisted as a private. He was discharged as a first lieutenant, commanding the Fifth Company of the Second Battalion at Camp McClennan, Alabama. He is now serving as a captain on the judge advocate's staff, New York National Guard.

He is founder and senior member of the law firm of Grace and Grace at 26 Court Street, Brooklyn. He was appointed counsel for Kings County of the Home Owners' Loan Corporation in 1933 and served in that capacity until appointed state director of the Federal Housing Administration in 1935.

He is a member of the New York State Bar Association, the Brooklyn Bar Association, American Legion, Crescent Athletic-Hamilton Club, and the Fox Hills Golf Club.

The process of buying a home under the Insured Mortgage System can perhaps be best illustrated by citing an actual case. Out of the Federal Housing Administration files in New York City I have taken, more or less at random, one transaction of thousands that we have closed, and I will present it to you step by step.

Bernard L. Osborne is a young man of 27 who is employed in the United States Post Office at Suffern, New York. Against the time he and his wife Helen, aged 23, might be able to build a home of their own he had acquired a plot of land. When the Insured Mortgage System came into being Mr. Osborne saw an opportunity to get the home he wanted at once. So he and Mrs. Osborne went to the Suffern National Bank and Trust Company and explained their needs. The bank under its obligation as an approved mortgagee made the usual investigation of Mr. Osborne's credit standing. This being entirely satisfactory, it agreed to assume a mortgage of $5,150, providing the Federal Housing Administration would insure.

The next step was for the bank to submit the plans and specifications to the Federal Housing Administration for approval and for a valuation on the completed structure. The former met all the requirements, and the latter was fixed by the government appraisers at $6,975, making the relation of the loan asked to the valuation 73.83%. As the government will insure up to 80% of valuation, the entire transaction was within the regulations, so a tentative commitment of insurance was issued and this became final when the structure was completed. The Osbornes are now living in their new home and paying off the mortgage in the monthly installments required by the law. These amount to approximately $52 a month, including interest, taxes and insurance, which certainly does not exceed the normal rental value of a $7,000 home.

Let us assume that when the plans and specifications were filed with the Federal Housing Administration they proved unsatisfactory. This would by no means vitiate the transaction. Ample opportunity would have been given Mr. Osborne to make the changes necessary to conform to the regulations. These latter are not irksome. They are the government's protection for its insurance obligation and the buyer's protection against inferior or dishonest construction.

The Engineered "HOUSE OF HEALTH" with Conventional Front and Country Club Backyard

By WILL RICE AMON, Architect

● IN AMERICA styles come and styles go, and the Colonial mansion which our ancestors created remains to us as an antique, a museum, but hardly a place for twentieth century Americans to live and work in. So it is with Victorian houses, and so it will be with our modern creations of glass and concrete and steel. But through all its changes from Colonial days to our own the American house has been America's significant contribution to architecture.

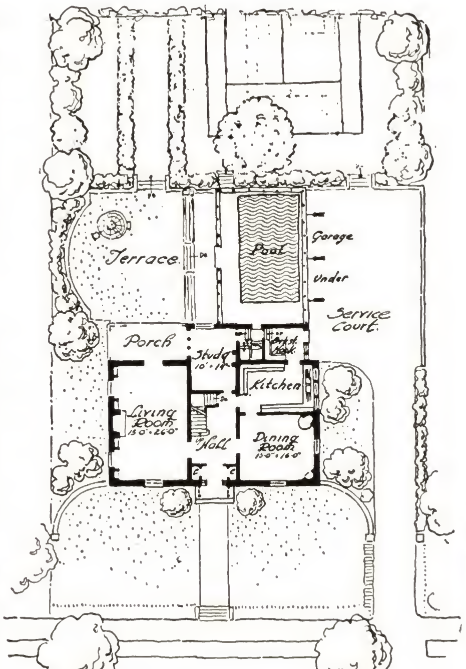
From our remote observation post we have watched the architecture of Europe, discarded much of what we found, and "borrowed" only those features which seemed to us to be worthy of our high standard of living. Today we see the architects of Europe forsaking the classical styles and answering the needs of the Continent with modernistic structures of reinforced concrete and glass—"functional" buildings, we are told—and they ask us to do the same. Conservation of space and materials, light, air, sanitation, and, above all, health are the keynotes of their program; and, indeed, they offer us much to think about. However, their problem is a different one, a socialistic one, and their new structures are built to house the working people of Europe. In America it is every man's ambition to have his own home and to live in it in his own way with his own comforts and his own relaxations. His needs are greater than those of the Continental laborer, his horizon broader, and his dwelling must provide him with more than a bed, a stove, and a bathtub.

The house illustrated here is designed to provide this average home-loving American with a healthy place to live and a beautiful one. It has room for comfort, for entertainment, for study, and room for healthy relaxation all year 'round. It is for the man with a family, sociable, energetic, and consciously striving to get all that life holds.

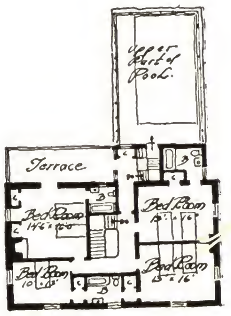
Plenty of space in the living room, dining room, and hall; privacy in the study; adequate kitchen and breakfast room; ample garage; concrete construction throughout, fireproof and permanent. Part of the basement is reserved for heating and air conditioning, part for a play room. Servants' rooms are on the third floor.

The feature of the house is a generous indoor swimming pool where family and friends can sport in the summer with glass doors open to the terrace and tennis court, and where all can have a morning and evening "dip" in the winter. By combining the pool with the garage it is possible in this fireproof construction to include this feature at a cost within the means of most suburban homeowners.

Coupled with this is the backyard. Time was when a backyard was useless; at best a flower-bordered

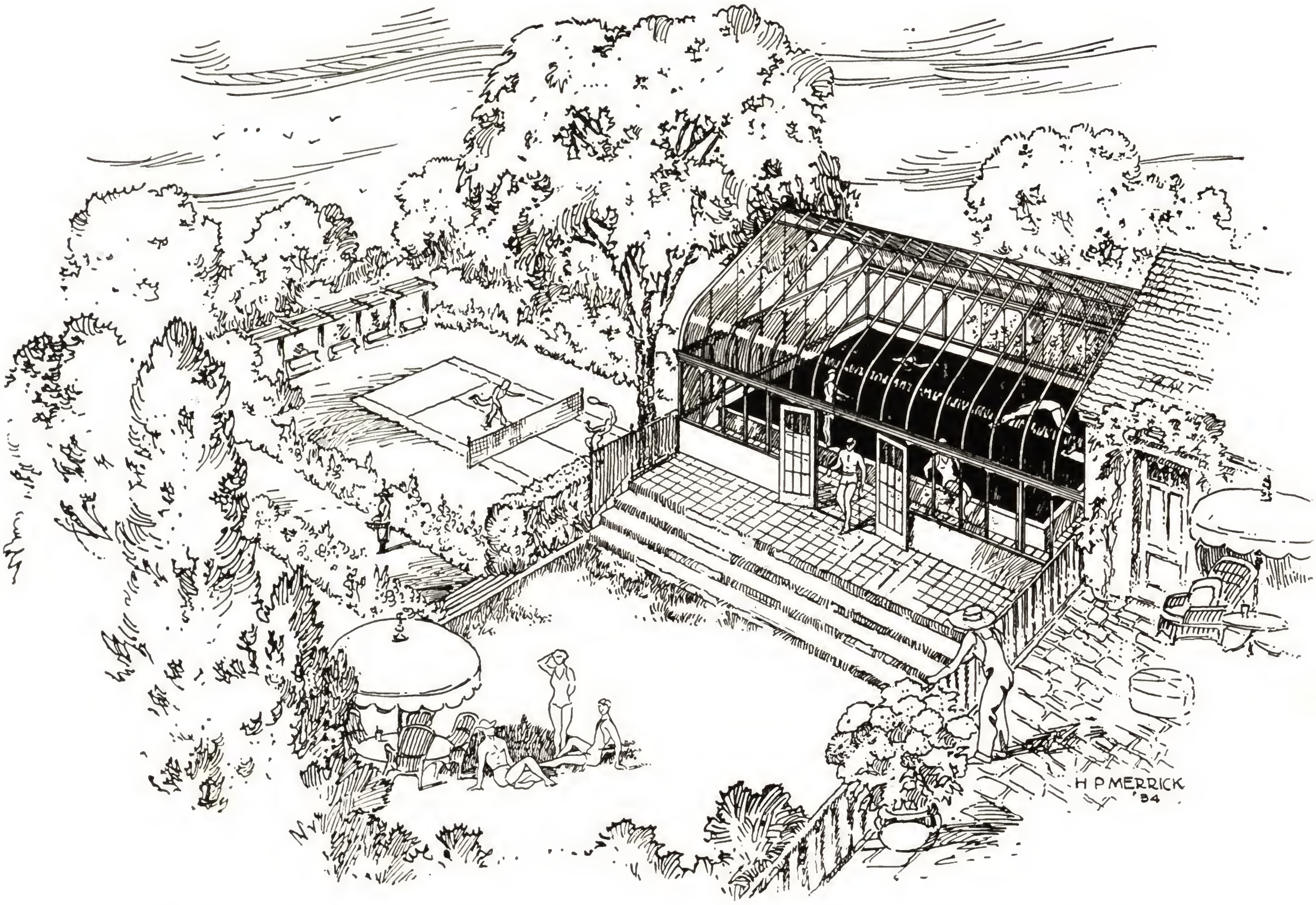


-First Floor Plan-



Second Floor Plan

lawn, at worst a dismal affair fenced in by high boards. Here is a different sort of place, a healthy pleasure resort in miniature, a retreat where country and seashore sports may be enjoyed at home. Swimming, tennis, basking in the sun, shade trees and umbrellas for a book or a nap. Outdoor sports in the open, indoor games on porch and terrace, and all in the privacy of one's own garden. And these relaxations need not end with summer. The pool is there and the flowers, too, under glass all winter.

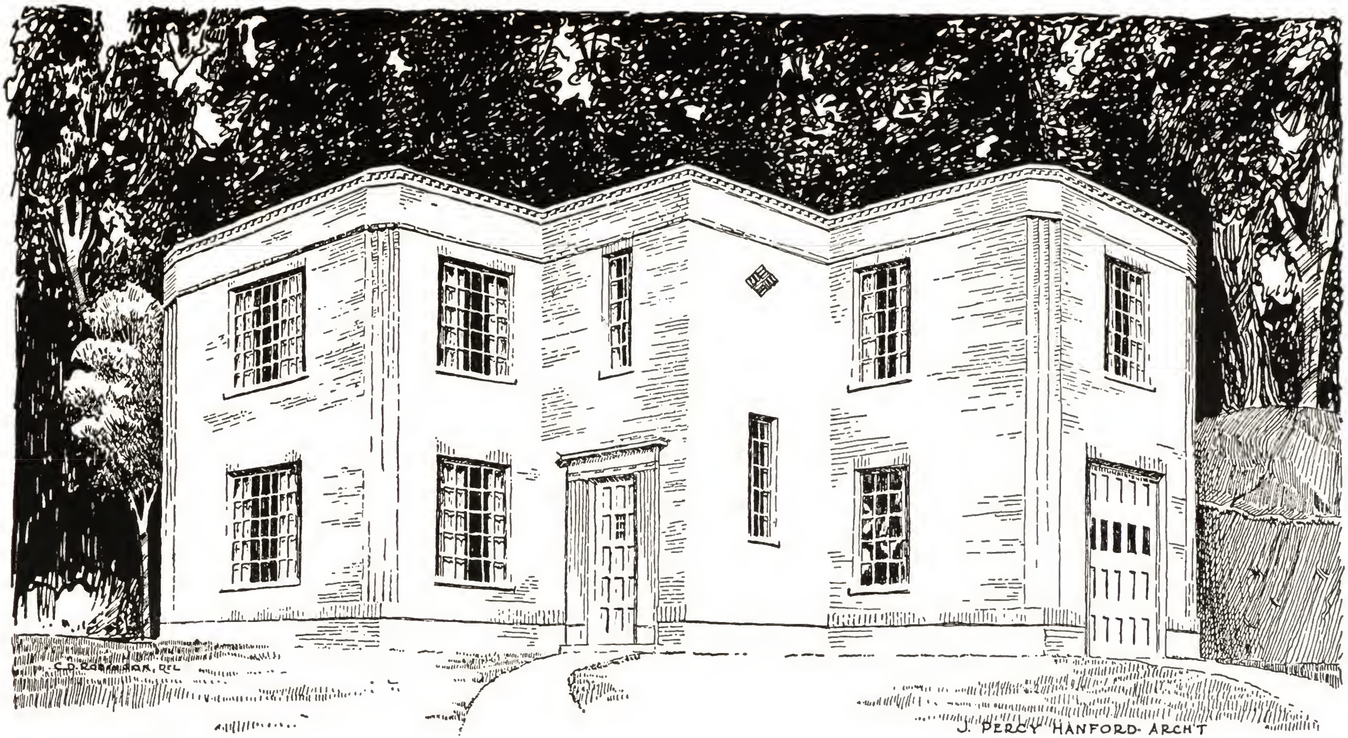


The Modern Backyard with Privacy, Swimming Pool, Grass Terrace, Tennis Court, Gardens, etc.

AUTHOR'S NOTES: This house seems to be a happy blending of old ideas in design and new ideas in construction. The introduction of an indoor swimming pool above the garage is quite unique but entirely practical. By placing bearing partitions between the automobile spaces it is possible to support the pool, fourteen feet wide by twenty-five feet long, on a six-inch concrete slab. The pool holds 1,740 cubic feet of water, costs only about three dollars to fill, and for family use need not be filled more often than once a week.

There are several rooms on the third floor, one large playroom and one handball court in the basement as well as a Turkish bath where the ardent health-seeker might go before or after his swim. With all these refinements this house can be built for $22,000.

Although a comparatively young man, Mr. Amon has a fine background of architectural training and experience. A graduate of Massachusetts Institute of Technology and the American School of Fine Arts, Fontainebleau, France, Mr. Amon has been the winner of outstanding architectural prizes in America and in Europe. He is in charge of the domestic architecture section of New York University's School of Fine Arts, and is one of the architects selected by the New York City Housing Authority to design forthcoming housing work in that city.



A HOUSE THAT CAN'T BURN

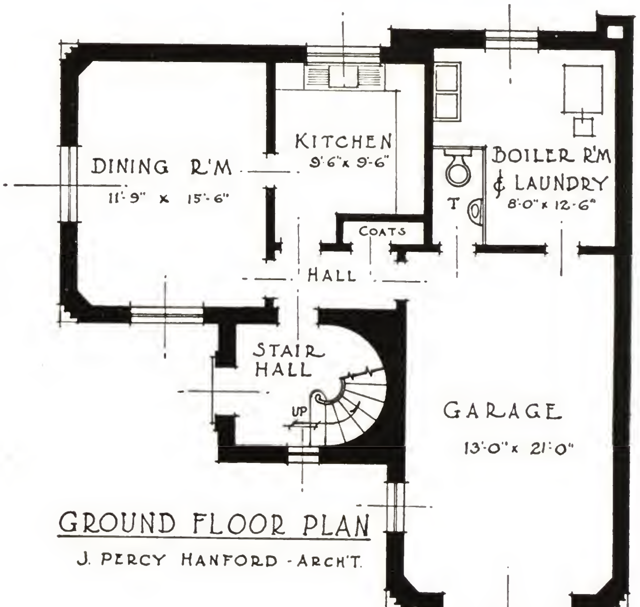
By J. H. HANSEN

Secretary Brick Manufacturers Association of N. Y.

● THE AUTHOR of this book, Odd Albert, has also contributed largely towards the development of economical and fire-safe house construction. The house illustrated here was built with low-cost unburnable floors of brick and steel which were developed chiefly by Odd Albert. The floor is a variation of reinforced brick masonry and allows even the lower-cost houses to enjoy all the safety of our modern apartment buildings. The architect, Percy Hanford, Newburgh, N. Y., with the co-operation of the owner and builder, J. A. Fogarty Construction Co. of Newburgh, N. Y., did not stop with safe floors but built the exterior walls of 8-in. solid common brick, and all partitions with soundproof U.S. Gypsum blocks. The result is that each room is practically a fireproof compartment, the contents of which could be completely consumed by fire without setting fire to any other room.

There are many prophets who predict the shape and form of the House of the Future, but any such house that is not safe from fire is but a wasted dream. For this reason this Newburgh house is described here in detail and proves that safety as well as convenience is within the reach of all.

Modernistic in style, it is built with common brick (JJJ Ivories) and is strictly functional in design. Built into the side of a hill, an unusual layout was found most practical. The garage door opens on the side leading directly to the mechanical parts of the house. This allows the homecomer to check the oil burner and hang up his clothes and wash before entering the dining room or kitchen. Or, if it is not lunchtime, without entering any other room he can climb the circular stairway to the



GROUND FLOOR PLAN

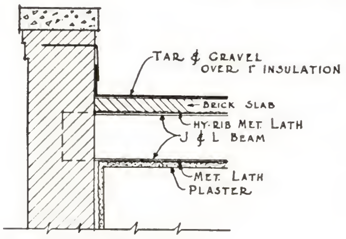
J. PERCY HANFORD - ARCH'T.

second floor living room, where a crackling fire in a real fireplace awaits him.

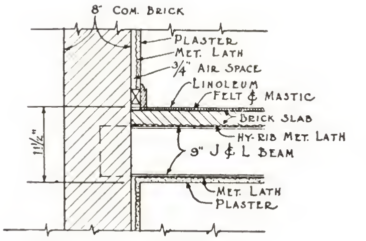
A study of the L-shaped floor plan will show a remarkable lack of wasted space. Yet note the 18-ft. living room and the extremely spacious garage leaving room for work space and easy access to the car doors. The well-lighted stair hall, though small, really appears large because of the light ornamental steel stairway that winds gracefully up to the second floor, with built-in bookshelves at the turns. The L-shaped plan provides an unusual amount of window space. The living room, with its three exposures and rounded interior corners, appears grandly formal until the cozy fireplace at the other end draws the eye. The two bedrooms have two exposures and are separated by the bathroom, which opens into a small cross hallway, thus allowing visitors to enter without passing through either bedroom. In fact, one may enter any room in the house without actually going through any other room. Seldom does a floor plan of a small house offer so much privacy and seclusion.

Although there are many interesting features that should be pointed out, the structural parts of the house itself deserve to be emphasized. Note the cross section below. The 8-in. common-brick walls, furred out, need no insulation, and the roof and floor are almost a foot thick, with a 9-in. air space to protect againt SOUND, HEAT and FIRE.

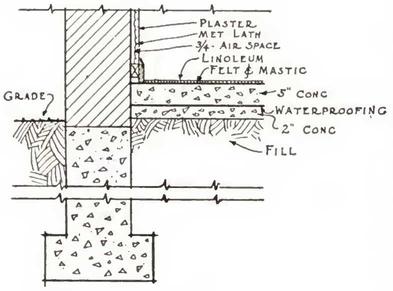
The unusual floors are simply constructed and cheap. Across 9-in. Jones & Laughlin steel beams, spaced 36 to 42 inches apart, ¾ in. Hy-rib metal lath were laid. Then the space between the Hy-ribs—¾ in.—was filled with a stiff mortar. On this the bricks were placed ½ in. apart both ways. Between the bricks ¼ in. round rods were dropped and the joints poured full of very thin mortar. This was allowed to harden and finished off with linoleum laid on felt and mastic. So simple that a child could build it. No form work or bracing or tools are required. And yet it is one of the strongest floors of its thickness known. At tests conducted at New York University, under the direction of Professor C. T. Schwarze and before the Building Department officials of New York City, such floor slabs carried over 2000 lbs. per sq. ft. Residential floors need only be designed to carry 40 lbs. per sq. ft. Such a brick-and-steel floor has practically no deflection or shrinkage, so plaster cracks on both wall and ceiling are eliminated. The original instructions for its construction were so simple that the workmen were positive it could not be done. Before they knew it, however, they had completed the job. Later, visitors were surprised at its soundproof qualities.



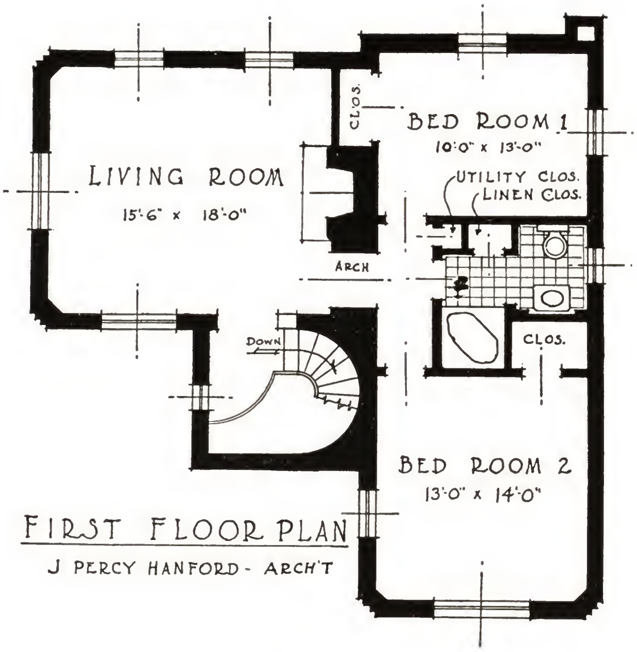
DETAIL OF ROOF



DETAIL OF FIRST FLOOR



DETAIL OF GROUND FLOOR



FIRST FLOOR PLAN

J PERCY HANFORD - ARCH'T

The roof, although covered with tar and gravel, can be reached by an outside stairway (not supplied) and covered with wood slats and used as a sun deck—protected by 3-ft. parapet walls, making it a safe play space for small children.

CONSTRUCTION FEATURES

Foundations—walls of brick with waterproofed concrete on side facing hill.

Exterior Walls—8-in. Hudson River common brick furred, metal lath and plaster (brick not painted).

Roof—reinforced brick masonry slab over steel beams, tar and gravel.

Doors—pine, by Curtis Mfg. Co.

Doors, Garage—Stanley overhead door.

Window Frames—Fenestra casement metal sash.

Glass—Pennvernon glass.

Interior Woodwork—White pine.

Floor—first, reinforced brick masonry slab on steel beams; ground floor, 9-in. concrete slab on dirt, waterproofed.

Floor Finish—Armstrong linoleum in felt and mastic.

Partitions—U. S. Gypsum soundproof block.

Interior Finishes—Color and paint combinations for floors, walls and draperies selected by Armstrong Cork Co., decorator.

Bathroom—New angle recess square bath tub and shower by Standard Mfg. Co., with medicine cabinet, hidden side lights, and waterproof Kenne's cement walls.

Heating—Storm King Oil Burner with Radiant Boiler, hot-water system, recessed radiation, thermostatic control.

Here, then, is a house—built as well and of as durable materials as exist today, complete with modern conveniences; and what does it cost? Mr. J. A. Fogarty, president of J. A. Fogarty Construction Co. of Newburgh, N. Y., stated that he will duplicate it on your lot—with some variations in design to suit—for eight thousand dollars ($8000).

VARIOUS EXTERIORS With Same Interior Plan

By VICTOR CIVKIN, Architect

● WITH A FEW EXCEPTIONS, any well-planned house can be made into practically any style exterior. The four different perspective views are made for the same plan and are shown here. These are only four examples of how the same plan can be treated.

It is a strange fact that when a person is renting a house, he is renting it for the interior layout, without paying much attention to the exterior. Just the opposite is the case in buying the house; the exterior in this case clinches the sale.

Any intelligent architect should design a house from the inside out. In other words, he should make a plan first and then fit the exterior to it. In making a plan, of course, he bears in mind the exterior.

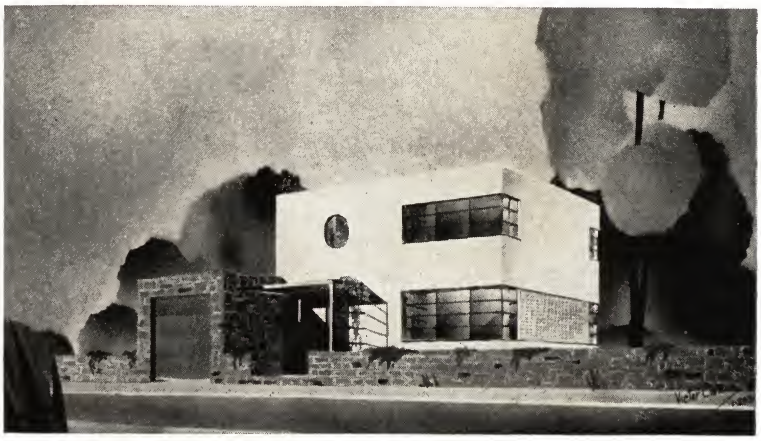
This plan is made for a very small house containing only 14,000 cubic feet. Due to the compactness of the plan and absolute elimination of waste space, the low cubage was obtained without sacrificing the sizes of the rooms, yet retaining all the qualities of a large house.

The dining room is part of the living room, but it can easily be separated, as the total space provided is large enough for a normal living room and small dining room. The entrance from the attached garage is located with a door into the dining-room space as well as to the front hall, making a perfect circulation. The toilet on the first floor is accessible from the kitchen as well as the living room.

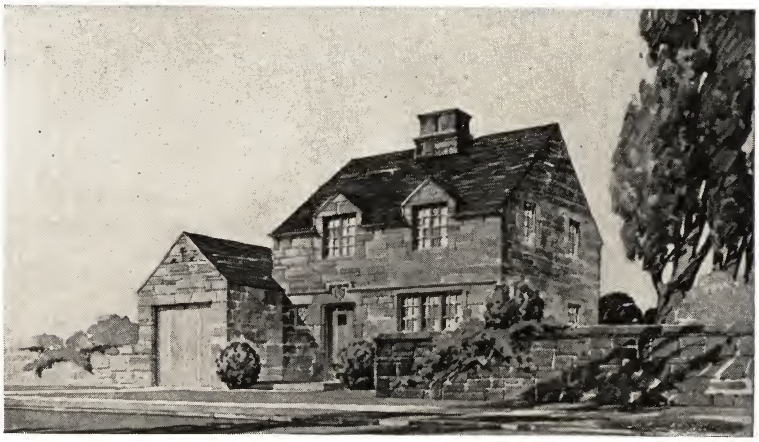
The kitchen equipment is composed of a General Electric Unit Kitchen, which is so flexible it can be added to or changed to any shape desired. In spite of the fact that the kitchen is rather small, the equipment is so arranged that there are enough work surfaces in between the major appliances, with a corner available for a table where the family can eat breakfast.

The basement could be fully excavated or partly excavated, as shown, leaving enough room for the heating and air-conditioning apparatus. The chimneys for the fireplace and furnace are in one stack.

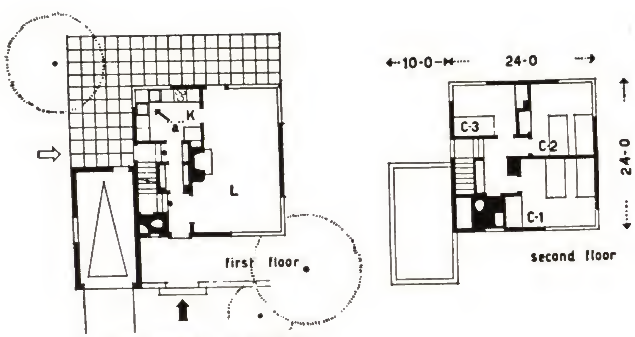
The second floor consists of three good-sized bedrooms so arranged that two of them could have twin beds. Ordi-



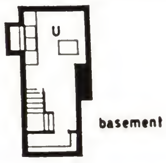
MODERN—*Not modernistic. Unlimited freedom in fenestration, complete elimination of unnecessary ornamentation. Possibilities for roof terraces. Functionalism and simplicity are the main factors of the well-designed modern exterior.*



ENGLISH—*Adopted in Pennsylvania. Stone exterior with deep windows, slate roof making the house look substantial and solid.*



L	living & dining	12-0 x 23-0
K	kitchen	8-0 x 10-0
C-1	chamber	11-0 x 12-0
C2	chamber	10-0 x 11-6
C3	chamber	8-0 x 10-0
U	utility	8-0 x 19-0



TOTAL CUBAGE 14,000 cu. ft.

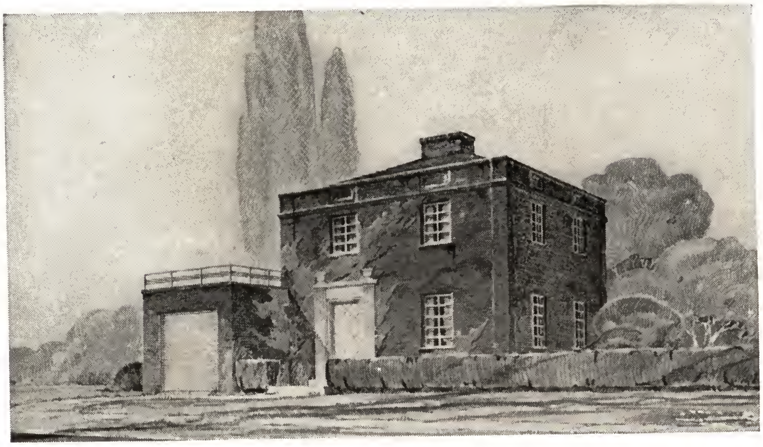
nary closets are substituted by a shallow wardrobe, full width and just deep enough for a coat hanger. These wardrobes are designed with drawers below for storage and doors above just high enough for a dress or coat. A linen closet and general storage closet are shown.

One good-sized bathroom on the second floor is directly over the toilet below, which simplifies the plumbing. Every bedroom has two exposures for proper ventilation, and the living room has three exposures. This plan is shown for a modern design, and by changing the window spacing it can easily be converted to suit any other design. This house can be designed of practically any material available and can be built completely equipped for the small sum of $6,000.

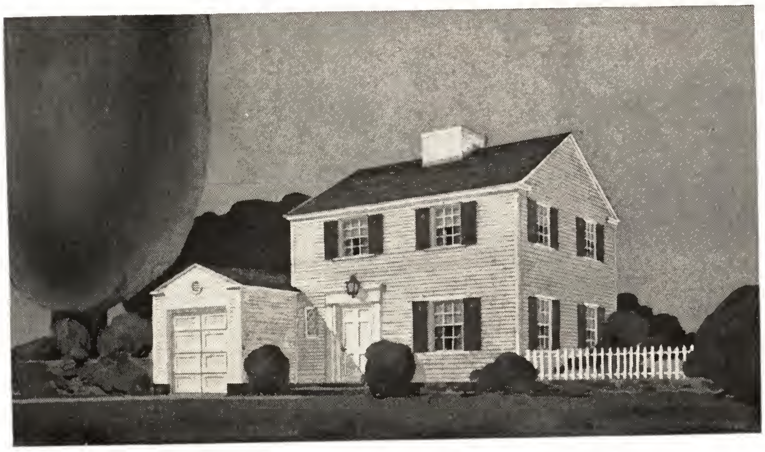
AUTHOR'S NOTES: Victor Civkin was born in Russia in 1898. His training includes four years at Kiev Polytechnic Institute, where he specialized in architecture and civil engineering, two years of architecture at the Riga Polytechnic Institute, and one year at the Ukranian Academy of Art. Then followed a year of military training at the School of Officers, where he studied military engineering. After three years of architectural practice in Europe, he passed his requirements for registered architect in Illinois, and later in Ohio and New York.

After ten years of general architectural practice he went with General Electric and is now managing the Architectural Service Department of the General Electric Home Bureau in New York.

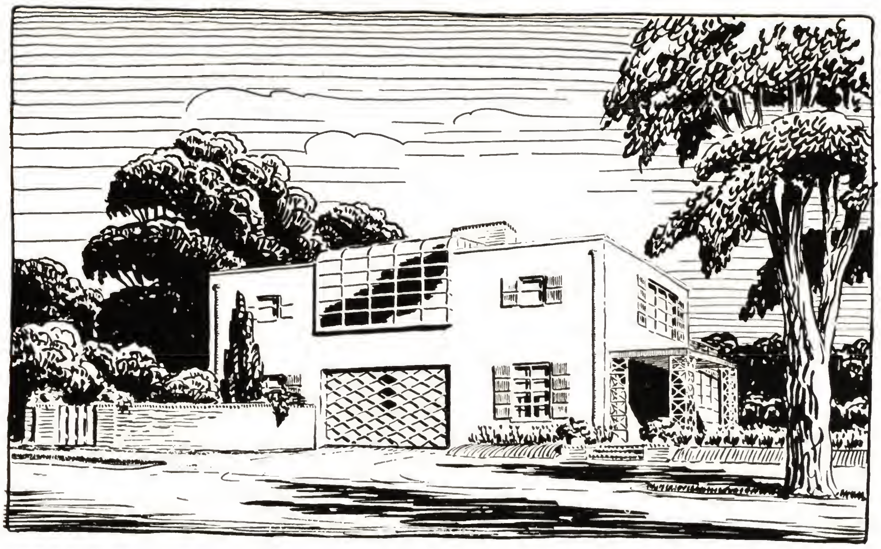
This department is equipped to give all necessary information to architects on the complete electrification of a home, including kitchen and laundry, air conditioning, wiring, etc. Mr. Civkin spent considerable time in the development of prefabricated houses. His major interest now is domestic architecture. He is a modernist in his approach to design.



GEORGIAN—*Brick exterior with straight, simple lines, heap roof with brick parapet, white window trim around the doorway makes a dignified appearance.*



EARLY AMERICAN—*White house with green shutters. This is the general definition of an early American design. Simplicity of form and proper proportion of the openings are the main factors of the well-designed exterior.*



A Thought-Provoking "HOUSE OF HEALTH"

Designed by THOMAS E. GREACEN, 2nd, Architect

● THEY TELL A STORY down South about Jake and Miranda, who spent most of their time sitting on the front porch rocking back and forth and letting the world go by. The big event of the town was Colonel Carter's funeral; but Jake and Miranda were too busy rocking to go to church; and in due course the funeral procession came up the road past the front porch. Quoth Jake from the depths of his rocking chair, "I declar' to goodness, Mirandy, if thar ain't the colonel's funeral comin' up the road. Thar's the parson, and the hearse, and the band. Why, Mirandy, the whole dinged town's out thar." But Miranda just rocked and rocked, and all she said was, "Aw, Jake, ain't it jest too bad I ain't facin' that way?"

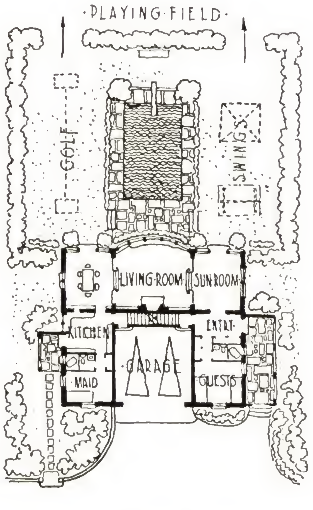
Your health and mine are a lot more important than the colonel's funeral, but are we not just a little like Jake and Miranda when it comes to doing anything about it? Why, for instance, do we permit so vital a consideration as health to play so small a part in the design of our houses? Do we imagine that the Fire Underwriters' Rules or the Building Code are comparable as health insurance to a little constructive thinking on our part? Some people take "setting-up" exercises and some play golf on Sundays; but real health cannot be built up in five minutes nor rescued on Sundays. It is the result of too many factors, and it is such a precious asset that we might well give it serious thought when we are planning a house.

Here is a house designed to satisfy some of the requirements of health, incorporating a good many relatively new principles of building, and it should provoke thought on the subject.

Approaching the house from the street, which we assume is on the north side, we drive into the garage which is located in the center, convenient to both owners and service. The house is fireproof, so this garage will be safe. We walk through the entry with a bedroom and bath adjoining and continue into the sunroom. This is on the south side of the house, and the living room, dining room and sunroom are arranged so that they can be used as one large room when occasion requires. The southern wall of these three rooms is made of glass and steel and we will hang curtains over some of the glass to shut out any sunlight we do not require. A swimming pool is right outside the living room with a putting green for grown-ups and swings and a "jungle-gym" for children on either side, and as large a field beyond these as we wish or can afford for badminton, "one-o-cat," or touch football.

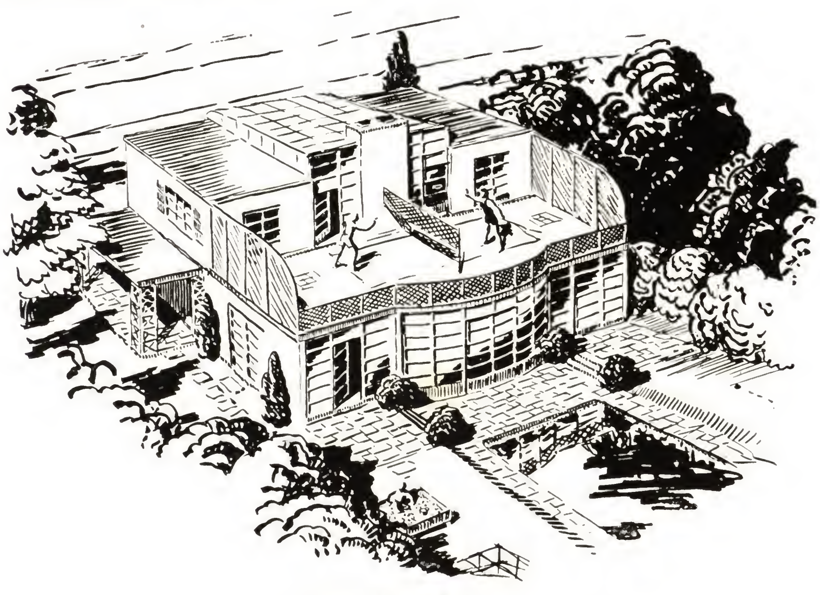
Upstairs is a recreation room with a large north window where we can work on a rainy day, make things, paint, draw, study, or play games indoors, or use it as a bedroom if we need another one. Doors open on the deck where we have borrowed two shipboard games—deck tennis and shuffleboard, both of which can be played almost all year round on an upstairs porch like this. The bedrooms are in opposite ends of the house with bathrooms which are accessible from the recreation room as well.

So much for the rooms. The house is built of reinforced concrete. It is fireproof and reasonably germ-

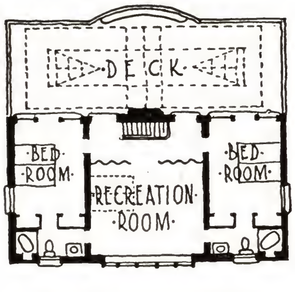


Plan of First Floor

proof. It is designed with large glass windows and doors to let in just as much sunlight as we wish. Down in the cellar we shall have a boiler, a conditioner, and a blower to deliver clean fresh air at an even temperature. Our roofs and walls are thoroughly insulated against dampness, heat and cold. We can keep our windows closed and circulate clean cold air at night, and sleep in peace and quiet.



Rear View of House



Plan of Second Floor

We can have an automatic garage door which will open when we drive up to it, automatic machines to wash our dishes and our clothes, central vacuum cleaning equipment. With machines like these to take the drudgery out of housekeeping, with thermostats mounting guard over us day and night, we will have time to bring up our children to be healthy and contented with a home that offers them more than the "gang at the corner" can ever offer; and we will have time and a suitable place to develop our own minds and our own bodies, and we will be pushing on in the direction of an ideal of usefulness and happiness which we are all striving towards.

AUTHOR'S NOTES: Mr. Greacen suggests here a simple and economical house. With its flat roof and rectangular plan it produces the maximum useful space at a minimum cost. A very small cellar is required because the recreation room is placed on the second floor, and why not? Furthermore, this house is designed so that it can be built upon a plot sixty feet wide. With a one-car garage instead of a two-car garage it could be built on a fifty-foot plot.

Mr. Greacen suggests it be built of modern materials, masonry walls and concrete floors supported on steel beams; and its modern character should be carried out by including such up-to-date products as Rock Wool insulation, air conditioning, a "General Electric Kitchen," and General Electric wiring.

Estimates received on this house range from $9,000 *to* $11,000, *depending upon the sizes of its rooms. The outdoor reinforced concrete swimming pool, fifteen feet wide and fifty feet long, should cost about* $1,200.

Mr. Thomas E. Greacen, who studied architecture at Princeton University and at the American School of Fine Arts, Fontainebleau, France, is a young architect with great possibilities. He has designed many successful small houses for clients in various parts of the United States and is the author of recently published articles on the subject of "Home Reconditioning with Government Aid."

The Yearly Cost of Running a "House of Health"

With a lot 60 x 200, costing $3,000, in a restricted neighborhood, the total cost of Greacen's house will be:

House	$10,000.00
Lot	3,000.00
Architect's Fee	600.00
Swimming Pool	1,200.00
Total Cost	$14,800.00

A five per cent government loan of $12,000 may be obtained, to be paid back in twenty years. The monthly payments will be approximately $80. The house is fireproof so no fire insurance is required. The masonry walls do away with painting, the floors are of solid construction, so the maintenance will be very low; conservatively, one-half per cent per year may be assumed. The house is very permanent and well insulated, so the fuel cost also is low.

Running Cost Per Year

Yearly payments on $12,000	$960.00
Tax—Approx. 2½% of 80%	300.00
Maintenance—½% of Total	74.00
Depreciation—½% of $11,800	59.00
Fuel	80.00
Total Cost	$1,473.00

It will be noted that the yearly running cost of this house is ten per cent of the total cost of the house and lot. Deducting the included monthly payments of $30 on the loan, the actual yearly cost is only $1,113.00, or about $93.00 per month.

The Yearly Cost of Running an Ordinary House

If an ordinary house had been built, the cost can be cut to $9,000. This house is not insulated and has to be painted every third year. A cheaper lot is used and there is no health-creating swimming pool. The cost will be:

House	$9,000.00
Lot	2,000.00
Architect's Fee	540.00
Total Cost	$11,540.00

A government loan of $9,000 may be obtained with monthly payments of approximately $60. This house needs fire insurance, requires more fuel, depreciates more, etc.

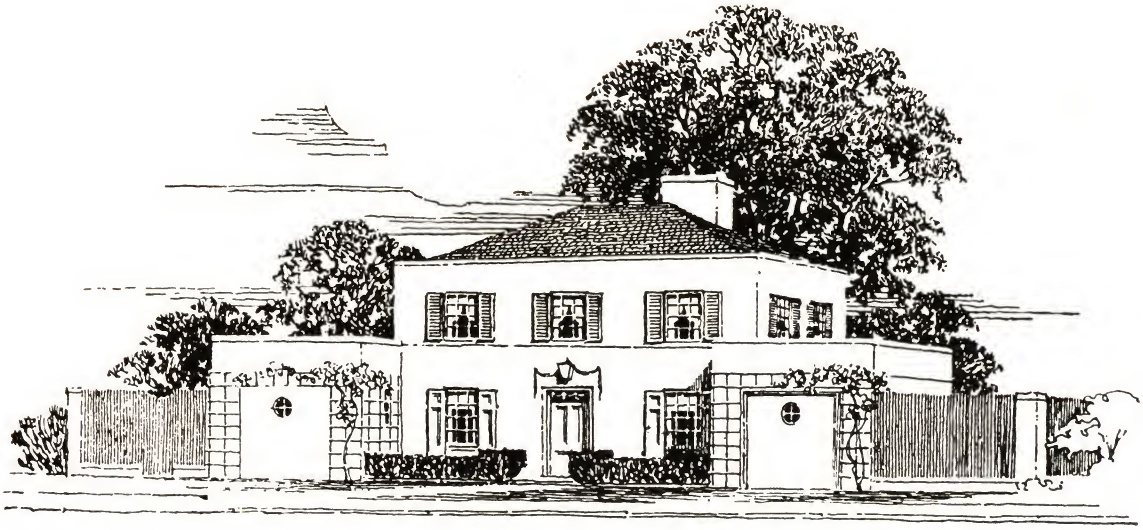
Running Cost Per Year

Yearly payments on $9,000	$720.00
Tax—Approx. 2½% of 80%	225.00
Maintenance—2% of Total	230.00
Depreciation—3% of $9,540	286.00
Fuel	130.00
Total Cost	$1,591.00

It will be noted that the yearly running cost is fourteen per cent of the total cost of the house and lot. Deducting the included yearly payments of $720 on the loan, the actual yearly cost is as high as $1,321, or about $110 per month.

Conclusions

The ordinary house is more than $3,000 cheaper than the "House of Health," and still it costs more to run. There is no swimming pool, not such a nice neighborhood, no oil burner, no insulation, and, above all, it is not fireproof; features that are obtained in the "House of Health" for that extra ten per cent. In cash you need only $260 more to obtain the $3,000 more expensive and more desirable "House of Health," that costs you $17 less per month to live in.



Designed for LIVING

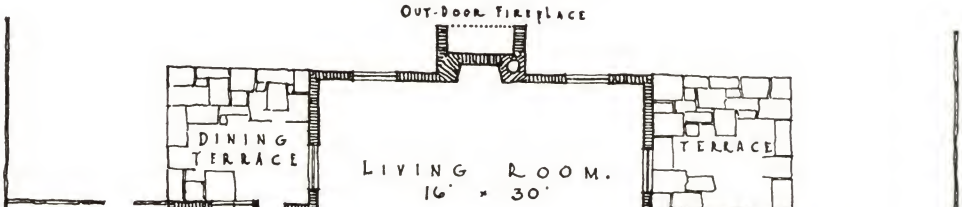
By PERRY M. DUNCAN, Architect

● A GREAT MANY PEOPLE think that a "Modern House" must be queer; it isn't modern unless it's strange. Yet everyone wants the comfort and convenience attainable in a modern home. We want sunlight and air, comfortable heating and ventilation, modern sanitary bathrooms and kitchens, rooms that are large enough to serve their purpose without being crowded, planned so as to decrease the labors of maintenance and increase the comforts of life. This would be my definition of a modern house; a house of health which provides a beautiful and healthful background for living.

The style of architecture selected is relatively unimportant. Different people have different tastes. Different generations have different standards of beauty. Our eyes become trained to perceive beauty from experience. The modern house must be the sum of all our experience, the logical development of all good architecture of the past. If it truthfully expresses its purpose, its beauty will be as enduring as the finest architecture of past ages. It will be as beautiful as the architecture which is to come in the future.

The house illustrated makes a feature of the living room. It has three exposures, looks out on a private garden in the rear, and opens on two terraces. These terraces on opposite sides of the house insure a shaded retreat in the morning or the afternoon. One of the terraces is accessible to the kitchen, making it easy to dine out of doors. An outside fireplace provides an added feature for cool October nights and picnic suppers. The living room divides naturally into three parts: one end for dining, the center portion for social purposes where the furniture groups around a large fireplace, and the other end for recreation, the space being ample for a card or game table, piano, radio, etc.

The kitchen, efficiently planned with cross draft and an abundance of light, connects with the living room through a dining alcove which would be useful for breakfast and informal meals. It serves as a pantry when the family dines more formally in the living room.



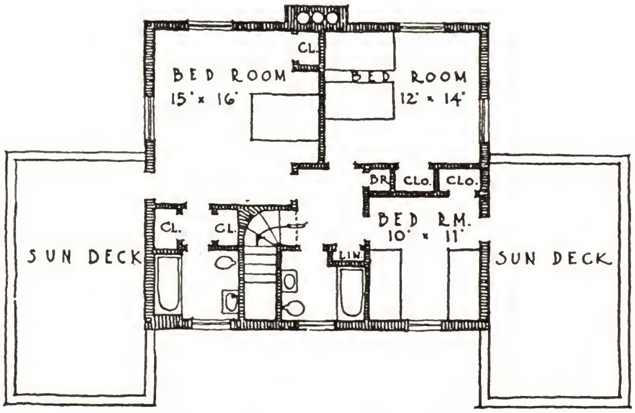
Plan of the First Floor

The study offers a retreat for any member of the family who wishes quiet for reading or writing away from the rest of the family. A built-in desk is provided, and though the room is small, it is large enough to accommodate a studio couch for an extra guest.

The garage is accessible to the living room through a vestibule which opens to the lavatory. This gives a two-door separation to both garages and lavatory from the living room. A tool closet opening on the garden is provided for garden implements.

Upstairs, all bedrooms have two exposures. Ample closet space is provided; two closets open on the hall, one for linen, one for brooms, vacuum cleaner, etc. The master's bedroom has three closets, one being cedar lined for storage of clothing not in constant use.

Two sun decks are provided on opposite sides of the house, insuring sun at all times of the day.



Plan of the Second Floor

The house contains 28,840 cubic feet and, based on a unit price of thirty-five cents per cubic foot, it is estimated it could be built for approximately $10,000.

AUTHOR'S NOTES: The house shown by Mr. Duncan probably will please quite a number of the readers. The house is planned for a lot one hundred feet wide. Since every entrance is from the front, and the property is fenced in, the backyard will offer complete privacy. Estimates given indicate that this house can be built for $10,000 *in the vicinity of New York. This price includes masonry walls, steel and concrete floors, insulation, air conditioning with oil furnace, and modern kitchen equipment.*

Mr. Perry M. Duncan, who is a young architect with great possibilities, has already made himself known by several remarkable houses designed and built, and from recognized writings in leading magazines. He was awarded the Gold Medal for the best house designed in 1936. Though the house shown here is rather expensive, Mr. Duncan has a known ability to design beautiful homes. costing less than $7,000.

Financial Independence at the Age of Sixty

(Tables referred to in this article will be found on pages 102 and 103.)

Let us consider an average American family with an annual income of about $3,000 who can afford to spend $900 on rent.

The life of a person can be divided into five cycles, the childhood up to ten years, the school days from ten to twenty, the self-supporting youth from twenty to thirty, the married life from thirty to sixty, and the old age from sixty on.

CHILDHOOD

As soon as a child is born, the parents put aside for it $12.00 per year. The Table B gives the value of $1.00 per annum for ten years at 5 per cent to be $13.207. The value of these savings will, therefore, be at the age of ten:

$$12 \times \$13.207 = \$158.48$$

The cost per year for the parents was $12.00.

SCHOOLDAYS

At the age of ten, the parents increase their contribution to $24.00 a year. The Table A gives the value of One Dollar Principal for ten years to be $1.629, and the factor for One Dollar per annum for ten years is found to be $13.207. The total value of these savings will, therefore, be at the age of twenty:

Value of Previous Savings, $158.48 × 1.629	$258.17
Value of New Savings, 24 × 13.207	316.96
Total Value at the Age of Twenty	$575.13

The cost per year for the parents was $24.00.

From now on the parents are relieved from these obligations because it is assumed that the children from this age are self-supporting.

COLLEGE EDUCATION

Often the parents also want to save money for a child's college education. It is assumed that a youth is ready for college at the age of eighteen and that it will cost $1,200 per year for four years.

The total amount spent on this education will be 4 × $1,200 = $4,800, of which $1,200 is paid at the beginning of the first year and the same amount again at the second, third and fourth years. The present value of One Dollar per annum for three years is found to be $2.723, so the total amount required at the age of eighteen would be:

Cash for First Year	$1,200.00
Present Value of Three Yearly Payments of $1,200 to be Paid the Second, Third and Fourth Years, $1,200 × 2.723	3,267.60
Money Required at Eighteen to Secure a Four-Year College Education	$4,467.60

If the payments are started at the birth of a child, there will be nineteen payments, the last at the eighteenth birthday. The Table E gives the Sinking Fund Factor to be 3.27 per cent. The nineteen payments over a period of eighteen years will, therefore, be:

$$.0327 \times 4467.60 = \$146.09$$

As a back check the total value of the College Fund minus one year interest must be obtained from Table B using the factor for nineteen years of 32.066 and the annual payments of $146.09. Hence:

146.09 × 32.066 × 0.9524 = $4,467.60

This means that parental yearly investments of $146.09 in nineteen years with 5 per cent compound interest will grow to $4,467.60 that will pay the child at the age of eighteen the sum of $1,200, and after then annual payments of the same amount for three more years.

The cost per year for the parents was:

For the Ordinary Saving	$ 24.00
For the College Education	146.09
Total Cost Per Year	$170.09

The parents thus can secure a child a good education and a bank account at the age of twenty of about $800.00, the college fund not included, by saving for it each month about $14.00.

In another chapter (Sound Home Ownership, etc.), it has been shown that by building a "House of Health," yearly savings of $260.00 have been obtained. This means that these savings more than pay for this child's college education.

THE HAPPY SELF-SUPPORTING YOUTH

As only a few are benefited with a college education, we will only consider in the following the average youth who starts to work before or at the age of twenty. He surely likes to increase the savings carried on so far by his parents and we may assume that he saves $120.00 per year. He marries at thirty. He also takes life insurance of $1,000 to mature at sixty for a yearly cost of $24.31.

At the age of thirty the total value of his savings are, if the factor 1.629 from Table A and the factor 13.207 from Table B are used:

Value of Previous Savings, $575.13 × 1.629	$937.79
Value of New Savings, $120.00 × 13.207	1,584.84
Total Value at the Age of Thirty	$2,522.63

His yearly expenses were:

Savings of $10.00 per month	$120.00
Life Insurance of $1,000	24.31
Total Cost	$144.31

AS A MARRIED COUPLE

It is assumed that both man and wife are of the same age and have the same amount of money. Therefore at their wedding day they can pool together $5,045.26. They continue to save $10 a month for another thirty years. Table B gives the factor for One Dollar per annum at 5 per cent for thirty years to be 69.761, and Table A gives the corresponding factor for One Dollar Principal to be 4.322. Their value will therefore be at the age of sixty:

Value of "Wedding Money", $5,045.26 × 4.322	$21,805.61
Monthly Savings at $10, $120 × 69.761	8,371.32
Life Insurance	2,000.00
Total Value at the Age of Sixty	$32,176.93

Their expenses were:

Monthly Savings of $10	$120.00
Life Insurance, 2 × 24.31	48.62
Savings for One Child, Over Ten	24.00
Savings for One Child, Less Than Ten	12.00
Total Cost Per Year	$204.62

WHAT HAPPENS IF THEY BUILD A "HOUSE OF HEALTH"

Let us assume they build a "House of Health" costing $8,000 to be ready on their wedding day. They pay down 20 per cent or $1,600 and obtain a twenty-year loan. Over this period the yearly cost of running the "House of Health" is found to be 8 per cent of $8,000 or $640 per year. The cost to live in an ordinary house has been found to be $900. Therefore the net savings from living in a "House of Health" is $260 per year. In another chapter it has been shown that these savings over a period of twenty years grow to $6,905, when deductions have been made for a 10 per cent larger purchase price of the "House of Health."

At the age of fifty their house is all paid for, and their value at this time is found to be (for factors 2.653 and 34.719 see Tables A and B):

Wedding Money, $5,045.26 — $1,600.00 = $3,445.26 × 2.653	$9,139.59
Monthly Savings of $10, $120.00 × 34.719	4,166.28
Savings from Living in a "House of Health"	6,905.00
House, $8,000 Less Depreciation of 1% Per Year, 80% × 8,000	6,400.00
Total Value at the Age of Fifty	$26,610.87

From now on their living expenses are $320 less per year, because their "House of Health" is free and clear. Before the loan was paid up, the yearly living cost in their house was $640, and now after the loan has been paid up, the yearly living cost is only $320. Not considering at all the "Ordinary House" that by now is more or less worn out, we will find that the couple at the age of sixty are fairly well off.

They have continued to save their $10 per month in addition to their other savings. They have invested their money in several other "Houses of Health," and as soon as the odd savings have grown to a sufficient amount, they are ready to invest in another house again. Thus their value at the age of sixty will be (factors 1.629 and 13.207 from Tables A and B respectively have been used):

Previous Savings $20,210.87 × 1.629	$32,923.51
Monthly Savings at $10, $120 × 13.207	1,584.84
Savings on Living Cost in "House of Health" $320 × 13.207	4,226.24
Life Insurance	2,000.00
House, $8,000 Less Depreciation of 1% Per Year 70% × 8,000	5,600.00
Total Value at the Age of Sixty	$46,334.59

This means that by building a "House of Health" to live in, their value at the age of sixty has increased from $32,176.93 to $46,334.59, an increase of over $14,000. But there are other advantages also. Their "House of Health" will enable them to continue to live inexpensively, saving in the future on housing alone every year $320.

AN OCTAGONAL HOUSE of Modern Construction

Designed by

BRADLEY DELEHANTY, Architect

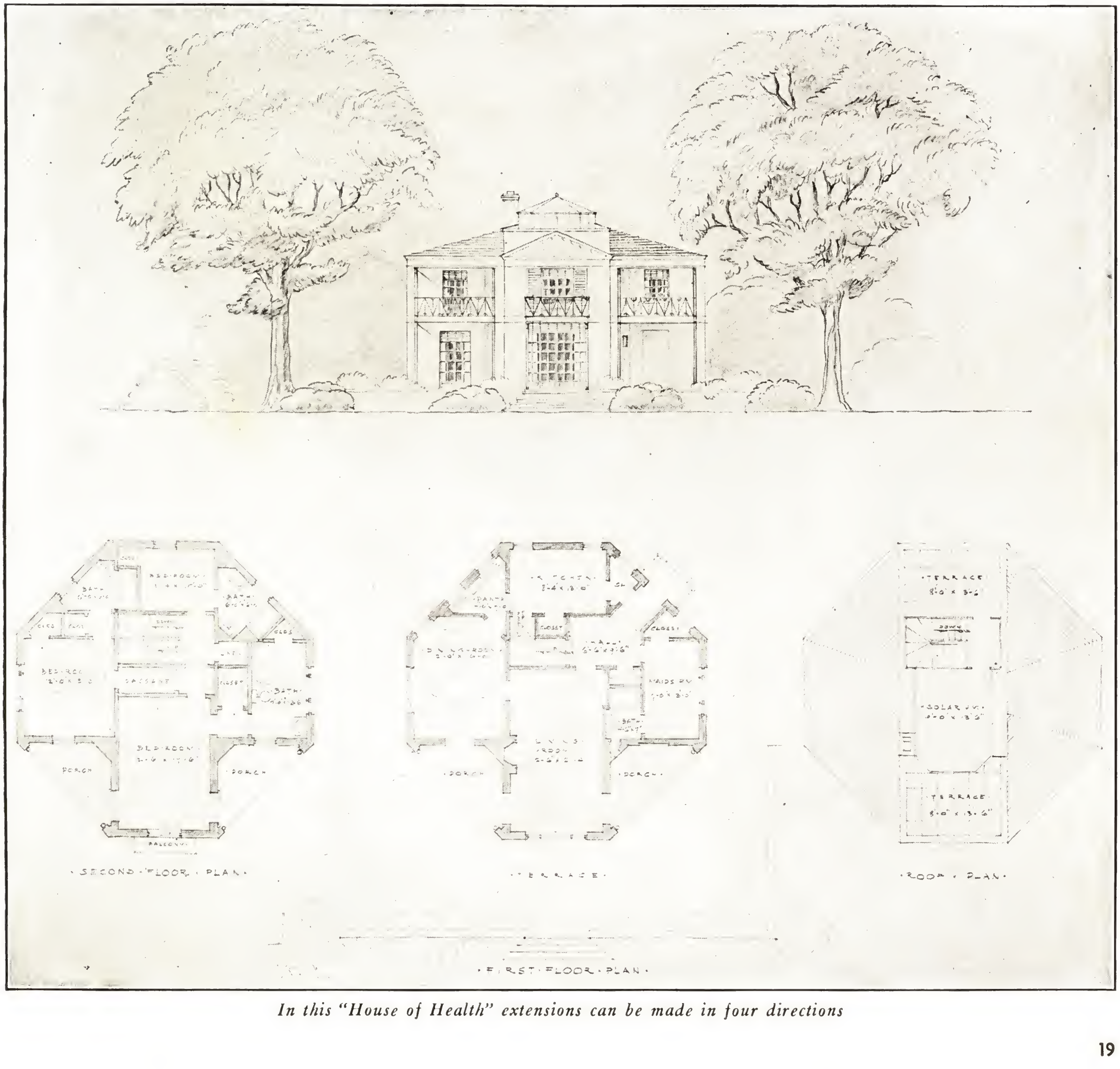
● DURING this age of modern and scientific building, there is increasing demand for moderate size houses embodying scientific planning, together with building materials, which will provide health, comfort and economy.

This octagonal house would have eight exposures, with large windows or doors on all of the eight sides, allowing for plenty of sunlight and air circulation. It would be thoroughly insulated, keeping out the cold in winter and heat in summer, and reducing greatly the fuel consumption. It would have an air-conditioned heating and ventilating system to assure uniform temperature with the proper amount of humidity.

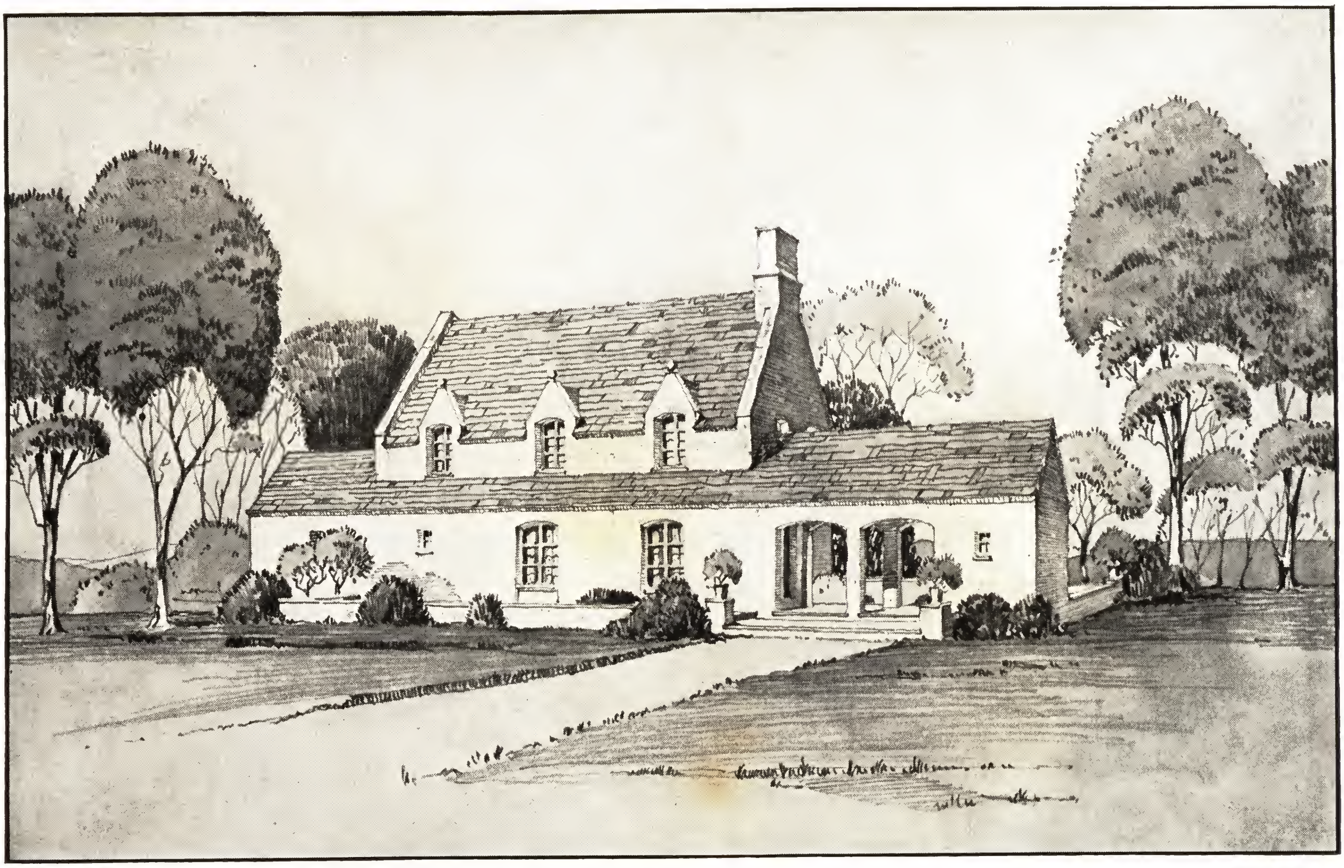
The solarium on the roof, for use on cold or chilly days, would be constructed of Vitaglass for health-giving sun rays. The open roof terraces could be used for sun bathing in milder weather. Each bedroom would have its own bath; there would be two sleeping porches for those who enjoy sleeping in open air.

The plan is compact in design, saving steps for the housekeeper, making it inexpensive to build and simple to maintain. It could be built on a fifty-foot lot or would also be suitable for a much larger area. It would make an ideal summer home for a small family or, if built in the suburbs, would be equally convenient for an all-year home.

The style of architecture is Southern. Examples on a much larger scale may be found in the vicinity of Louisiana. For those favoring the modern style, this plan would lend itself ideally to its use. In developing or elaborating this scheme, a more adequate kitchen, service porch, etc., could be worked out in harmony with the design.



In this "House of Health" extensions can be made in four directions



A "House of Health" of English Cottage Architecture

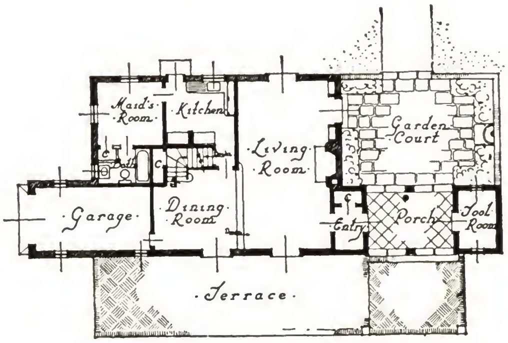
Two Compact and Economical "HOUSES OF HEALTH"

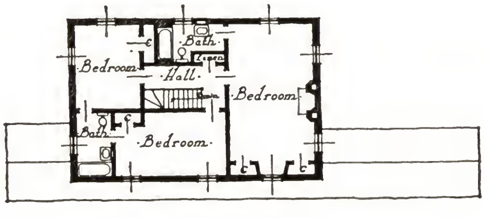
Designed by FRANK J. FORSTER, Architect

● AMONG the many factors that have a bearing on the present-day construction of a house, the one of economy is of primary importance.

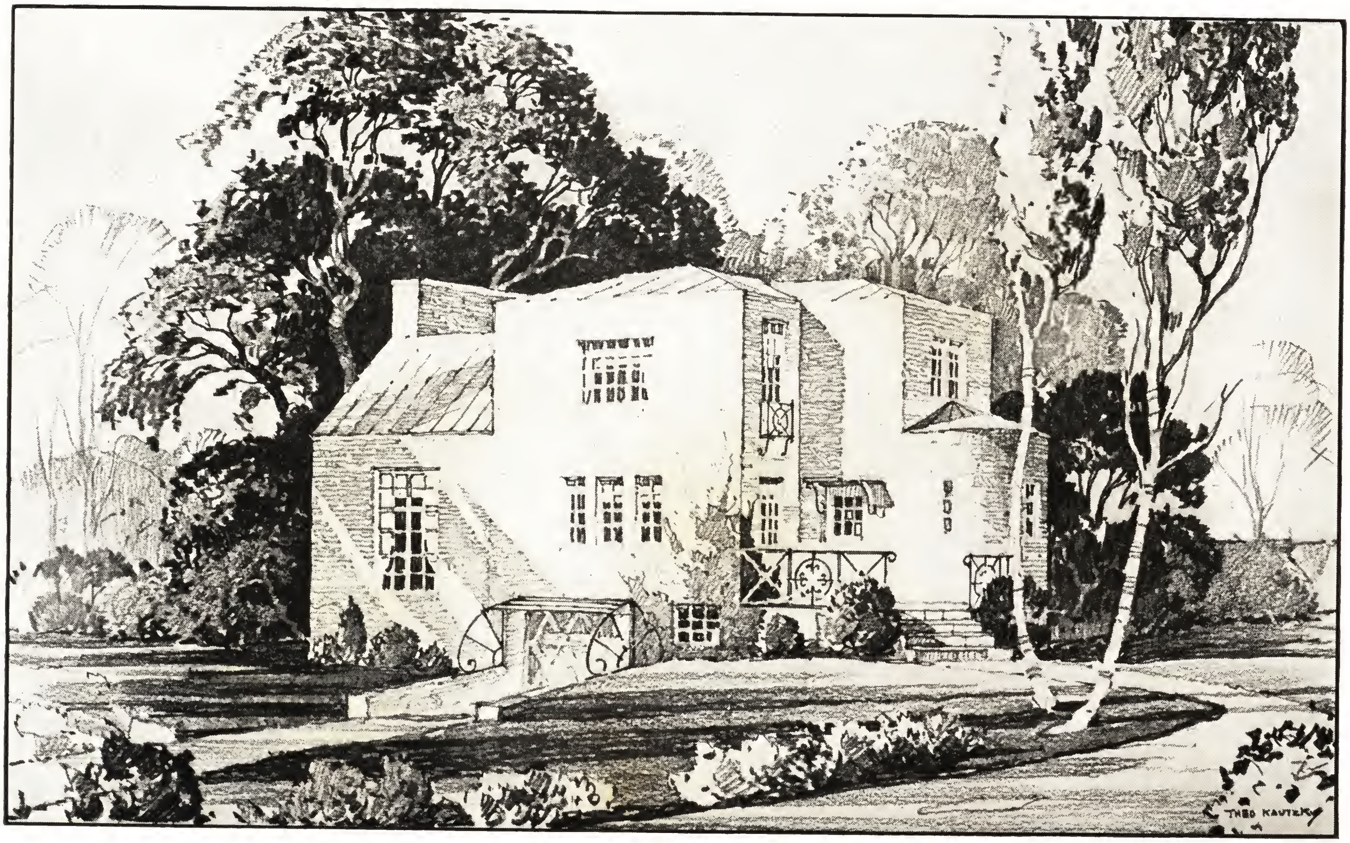
Economy must be considered within reason and not confused with cheapness. Cheap construction is not economy. During the last boom period, thousands of cheap and badly designed houses were built by unscrupulous builders and remain unoccupied, or a burden of responsibility to their owners. Many of these houses were built from expensive stock plans, expensive because they were inaccurate and lacking in necessary detailed information, necessitating costly changes, inefficiency in construction, and waste. Obviously the final results from such inefficient procedure must spell a bad investment.

Contrasted to this procedure, the services of an architect are designed for prevention of waste. They include advice on the selection of a proper building site with rela-





Second Floor Plan



A "House of Health" of Modern Architecture

tion to surroundings, values and public utility service; the preparation of sketches to conform with individual requirements and budget; the preparation of complete working plans and specifications describing the complete construction in every phase of the work.

These two houses are planned with the idea of compactness, economy and simplicity of design. They are ideal "Houses of Health"; every inch of available space is made serviceable. They are planned to be built by the latest improved methods of construction and installed with the latest improved devices in utilitarian equipment.

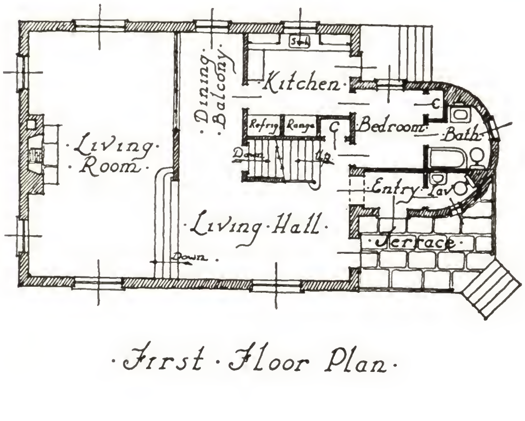
The general design of the first house is a modified adaptation of English Cottage architecture.

The arrangement of the first-floor plan differs from the usual floor plan in the fact that the space ordinarily occupied by the hall serves the purpose of the dining room. The small entry and coat closet off the living room leads in from the porch. At the end of the porch the small garden and tool house may also serve the purpose of a workshop, or, if built partially of glass, it could serve as a small greenhouse.

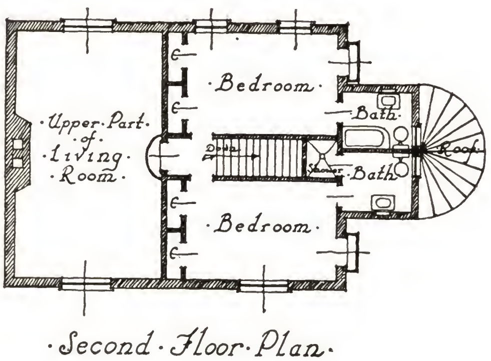
The garage is an integral part of the structure and has direct access to the main house. The garden leading directly off the porch has a flagstone floor and planting beds and is enclosed by a low brick wall.

A maid's bedroom and bath leads off the kitchen. The second floor has three bedrooms and two baths.

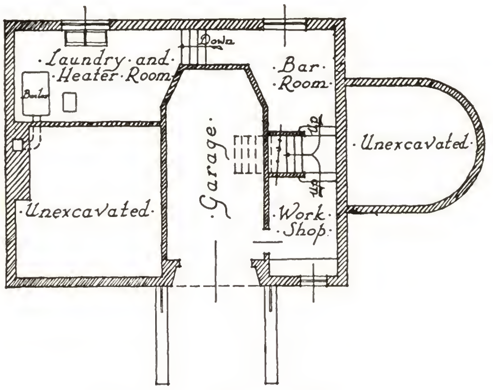
The cubic foot content of this house is 30,790 cubic feet, and it can be built at approximately thirty-five to forty-five cents per cubic foot.



·First·Floor Plan·



·Second·Floor·Plan·



· Cellar · Floor · Plan ·

The second house, which is modern in spirit, is unique in that the usual hall, dining room, and living room partitions are eliminated, thus affording one large open room which gains additional interest from a change in floor and ceiling levels. The living-room portion of this large general room is four steps lower than the dining balcony, which adjoins the large living hall and entry. The lower level of the living room is two stories in height and contains a fireplace. Above the dining balcony is a second-floor balcony looking into the living room. At each end of the room are large windows, supplying generous light and ventilation. The whole effect is one of hospitable spaciousness.

The kitchen is on the upper level, conveniently located near the dining balcony. It is designed for efficiency, and contains space for sink, refrigerator, range, dressers, and dishwasher. Adjoining the kitchen is a bedroom and bath, which may be used either as maid's quarters or as an additional guest room. A small entry and separate toilet are provided on this floor. The second floor has two bedrooms, each with a bath. Ample closet space is provided in these rooms, and a small outdoor balcony leads off from each bedroom.

The highest portion of the first floor is six steps above the natural grade level and permits access to the basement garage by an easy ramp leading down from grade. It also admits a generous supply of direct light and air to the basement rooms. In addition to the garage, the basement contains a laundry and heater room, a workshop and a barroom.

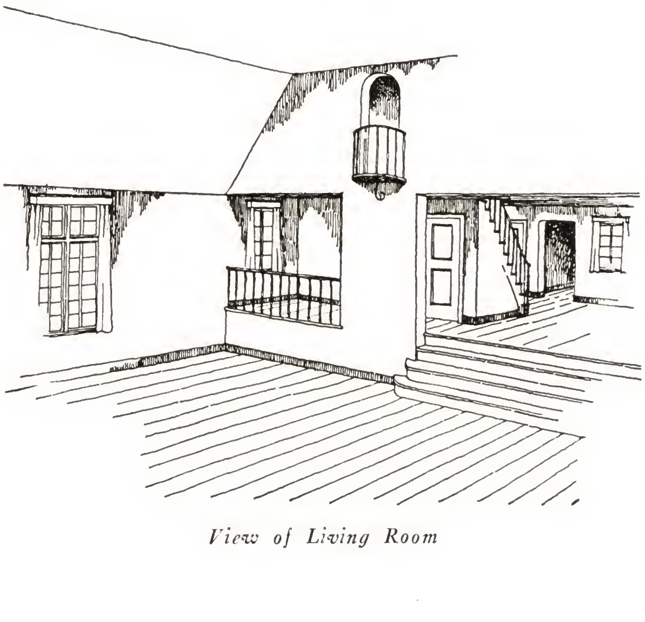
The total cubic foot content of this house is 26,000 cubic feet, and it can be built at approximately the same cost as the preceding house, namely, thirty-five to forty-five cents per cubic foot.

It is planned to heat both these houses with air-conditioning systems, the installation of which is simplified because of the compactly arranged mass and because all exterior wall and roof surfaces are planned to be insulated with cork insulation three inches thick. The exterior wall and roof structures are designed to utilize one of the latest improved methods of steel framing, the members of which receive the insulating cork units. The combination of steel and cork forms the solid walls and roofs. The material used for covering the exterior walls is optional; it may be a veneer of brick, stone, stucco or wood. The roof also has a choice of materials. In the accompanying design for the modern house it is planned to use whitewashed brick walls with a standing seam copper roof, and for the English house a slate or asbestos shingle roof. These selections are appropriate to the character of the designs. The finish of the interior walls and floors is also optional, depending on the character of the interior treatment desired. The landscaping of the grounds will depend upon the nature of the building site. The acompanying perspectives illustrate attractive settings.

AUTHOR'S NOTES: Mr. Frank J. Forster has excelled in the design of intimate country houses, large and small, throughout his career as a practicing architect. His remarkable book "Country Houses" was devoted entirely to a collection of his work.

He was recently awarded an Honorable Mention and Bronze Medal in the 1933 Better Homes Small House Architectural Competition for the house of Professor Franklin Edgerton at Yale University in New Haven, Conn.

This is not the first time that his outstanding ability as an architect has received widespread recognition. Awards in three different years were presented to him by The Architectural League of New York City; in 1927 he received the Silver Medal for the design of the residence of Karl Keffer, at Great Neck, L. I., and the Silver Medal of the League again in 1929 for the "excellence of his residential work." The Architectural League also awarded him First Mention in 1928 for "small house composition that is brilliantly conceived and is executed with great charm and character." Examples of his work are to be found in many parts of the United States, for he has built houses in Texas, Florida, Minnesota, Ohio and Pennsylvania as well as in New York, New Jersey and Connecticut.



View of Living Room

FRAME CONSTRUCTION

● CHEAP CONSTRUCTION and jerry-building are identical. As the frame house is the least costly to build, jerry-building is almost exclusively connected with frame construction.

THE HIGH COST OF CHEAP CONSTRUCTION

Jerry-building has exacted its toll from the home-building public, which has been forced too long to pay the high cost of cheap construction. The layman, watching frame erection, sees what appears to be a confused tangle of structural lumber. When the house is finished it appears to be good. The costly faults caused by "corner cutting" in frame erection do not make themselves known at once. But as time goes on, the need for repairs multiplies. The flood of unforeseen repair bills mounts as the hidden weaknesses in the frame produce sagging, squeaky floors, sprung doors, windows which cannot be opened, leaky walls and roofs, and even worse.

HOW TO INSURE GOOD CONSTRUCTION

Good material, properly used—that is all there is to this all-important matter of good construction.

In this chapter engineering data and construction details are given. These have been prepared with the aid of highly skilled architects and engineers experienced in residence construction. The nation's best building authorities have been consulted and their ideas sifted and tested until a consensus of opinion on the best practices has been developed.

Strength, rigidity, permanence, lasting comfort, freedom from annoyance, reduction of upkeep, are all obtained through the application of these construction principles.

House building is not difficult to understand. A house has comparatively few main parts, and its erection is not complicated. Consider this simple grouping of the principal parts of a house frame:

The foundation
The floor framework, consisting of bearing posts, girders and joists
The walls and partitions built of studding
The roof

FOUNDATIONS AND FOOTINGS

However carefully a building may be framed, an inadequate foundation will result in uneven settlement, cracking of plaster or bathroom tile, etc., which will offset, to some extent, the advantages of good work in the superstructure.

Therefore, footings should be made large enough that the load per square foot will not exceed the bearing capacity of the soil.

THE WOOD POSTS

A bearing post or column is a vertical member designed to carry an important load. A foundation supports it either directly or indirectly. In light-frame construction the post in the basement supports the girder. (A post will carry the load on a girder to the mid-point of the span on both sides.)

The utmost care should be exercised in deciding upon the size, type, and material of the post, and in seeing that the post is properly seated in an adequate foundation.

Because of their great strength and ability to withstand abuse, the small space required, and their relatively low cost, timber posts are deserving of more general use than is common.

In order to determine the size of posts, the following table is given. From the column on the left side of the table select the determined load. (The general principle of the design is shown in the diagram on the following page.) Then go across to the column corresponding to the length of the post. The figure at the intersection represents the size of post to use.

In the basement the minimum size column shall be 6″×6″. In a small house it will often be found that a smaller column can be used. However, in a basement, a column is subject to various kinds of damages, and, therefore, this minimum size is recommended.

SIZES OF WOOD COLUMNS FOR VARIOUS LOADS AND COLUMN HEIGHTS
Based on Use of No. 1 Common Douglas Fir

Load on Column (lbs.)	Length of Column					
	5′-0″	6′-0″	6′-6″	7′-0″	7′-6″	8′-0″
	Nominal Size of Column Required					
10,000	**4x6 in.**	**4x6 in.**	**4x6 in.**	**4x6 in.**	**4x6 in.**	**4x6 in.**
15,000	4x6	4x6	4x6	4x6	**6x6**	**6x6**
20,000	**6x6**	**6x6**	**6x6**	**6x6**	6x6	6x6
25,000	6x6	6x6	6x6	6x6	6x6	6x6
30,000	6x6	**6x8**	**6x8**	**6x8**	**6x8**	**6x8**
35,000	**6x8**	6x8	6x8	6x8	6x8	6x8
40,000	6x8	6x8	**8x8**	**8x8**	**8x8**	**8x8**
45,000	**8x8**	**8x8**	8x8	8x8	8x8	8x8
50,000	8x8	8x8	8x8	8x8	8x8	8x8
55,000	8x8	8x8	8x8	8x8	8x8	8x8

Reference—Page 50, Bulletin No. 145, National Committee on Wood Utilization, U. S. Department of Commerce, "Light Frame House Construction."

THE ROOF RAFTERS

The roof rafters, the framing members of the roof, must be of sufficient strength to support the weight of the roof, to carry the snow load, and to resist the wind pressure without sagging.

The regular rafters are the straight-run rafters, extending without interruptions from eave to ridge.

As plaster is not generally applied to the underside of rafters, it is not necessary to adhere to the 16-inch spacing. Spacing is determined more by stiffness of sheathing between rafters, by the weight of the roof, and by rafter span. Spacings from 16 to 24 inches are common, but for ordinary roof sheathing 20 inches is a common spacing.

The table here on "Size of Rafters" will give the proper sizes of rafters to use for a 16-inch spacing. It must be remembered that the rafter span is the horizontal distance between supports and not the length along the rafter.

SIZES OF RAFTERS FOR VARIOUS SPANS AND LOADS

Rafters Uniformly Loaded—Slope of 20° or More—Spaced 16 in. O. C.—Not Plastered
Based on Use of 4-SQUARE Guide-Line FRAMING

Span—Unsupported Lengths from Plate to Ridge—Without Collar Beams

Length of Span	Live Load in Pounds per Square Foot of Roof Area							
	15 lbs.		20 lbs.		30 lbs.		40 lbs.	
	Nominal Size of Rafters Required							
	Douglas Fir	W. Coast Hemlock	Douglas Fir	W. Coast Hemlock	Douglas Fir	W. Coast Hemlock	Douglas Fir	W. Coast Hemlock
7′ or less	**2x4 in.**	**2x4 in.**	**2x4 in.**	**2x4 in.**	**2x4 in.**	**2x4 in.**	**2x6 in.**	**2x6 in.**
7′-6″	2x4	2x4	2x4	2x4	2x4	**2x6**	2x6	2x6
8′-0″	2x4	2x4	2x4	2x4	**2x6**	2x6	2x6	2x6
8′-6″	2x4	2x4	2x4	2x4	2x6	2x6	2x6	2x6
9′-0″	2x4	2x4	2x4	**2x6**	2x6	2x6	2x6	2x6
9′-6″	2x4	**2x6**	**2x6**	2x6	2x6	2x6	2x6	2x6
10′-0″	2x4	2x6	2x6	2x6	2x6	2x6	2x6	**2x8**
10′-6″	**2x6**	2x6	2x6	2x6	2x6	2x6	**2x8**	2x8
11′-0″	2x6	2x6	2x6	2x6	2x6	2x6	2x8	2x8
11′-6″	2x6	2x6	2x6	2x6	2x6	**2x8**	2x8	2x8
12′-0″	2x6	2x6	2x6	2x6	**2x8**	2x8	2x8	2x8
12′-6″	2x6	2x6	2x6	2x6	2x8	2x8	2x8	2x8
13′-0″	2x6	2x6	2x6	**2x8**	2x8	2x8	2x8	
13′-6″	2x6	2x6	2x6	2x8	2x8	2x8	2x8	
14′-0″	2x6	2x6	**2x8**	2x8	2x8	2x8	2x8	
14′-6″	2x6	**2x8**	2x8	2x8	2x8	2x8		
15′-0″	2x6	2x8	2x8	2x8	2x8			
15′-6″	**2x8**	2x8	2x8	2x8	2x8			
16′-0″	2x8	2x8	2x8	2x8				
16′-6″	2x8	2x8	2x8	2x8				
17′-0″	2x8	2x8	2x8	2x8				
17′-6″	2x8	2x8	2x8					
18′-0″	2x8	2x8	2x8					

Note—Allowable fiber stress for Douglas Fir—1200 lbs. per sq. in.

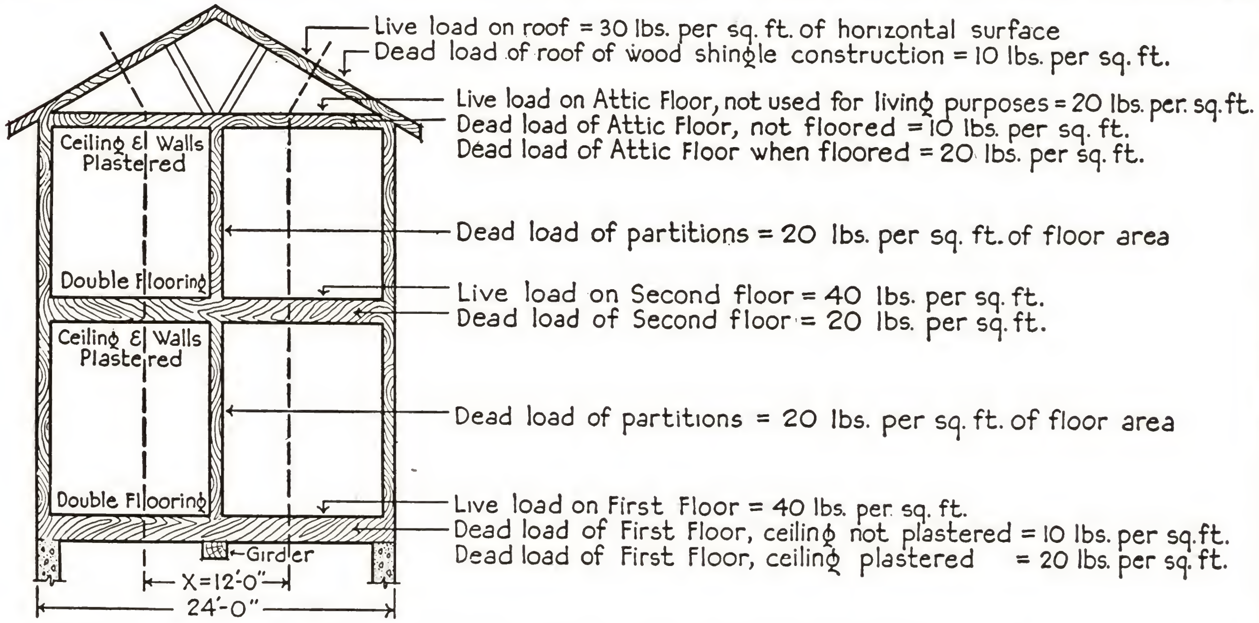
Allowable fiber stress for West Coast Hemlock—1040 lbs. per sq. in.

These figures provide for Dead Loads as follows: Weight of Rafters; Weight of Roof Sheathing (2.5 lbs. per sq. ft.); Weight of Roof Covering (2.5 lbs. per sq. ft.).

This roof covering will provide for wood shingles, metal sheets, metal tile or composition roofing. If heavier material is used, make the necessary allowance by using figures for a proportionately heavier live load.

Reference—Pages 19, 20, 21 and 22—"Maximum Spans for Joists and Rafters" by National Lumber Manufacturers' Association.

DIAGRAM SHOWING METHOD OF FIGURING LOADS FOR HOUSE FRAMING


Live load on roof = 30 lbs. per sq. ft. of horizontal surface
Dead load of roof of wood shingle construction = 10 lbs. per sq. ft.
Live load on Attic Floor, not used for living purposes = 20 lbs. per. sq. ft.
Dead load of Attic Floor, not floored = 10 lbs. per sq. ft.
Dead load of Attic Floor when floored = 20 lbs. per sq. ft.
Ceiling & Walls Plastered
Double Flooring
Dead load of partitions = 20 lbs. per sq. ft. of floor area
Live load on Second floor = 40 lbs. per sq. ft.
Dead load of Second floor = 20 lbs. per sq. ft.
Ceiling & Walls Plastered
Dead load of partitions = 20 lbs. per sq. ft. of floor area
Double Flooring
Live load on First Floor = 40 lbs. per sq. ft.
Dead load of First Floor, ceiling not plastered = 10 lbs. per sq. ft.
Dead load of First Floor, ceiling plastered = 20 lbs. per sq. ft.
Girder
X=12′-0″
24′-0″

SIZES OF JOISTS FOR VARIOUS SPANS AND LOADS
JOISTS SPACED 16 IN. O. C. UNIFORMLY LOADED
Based on Use of 4-SQUARE Guide-Line FRAMING

(Plastered Ceiling Below—Deflection not over 1/360 of Span)
Allowable Fiber Stress for Douglas Fir—1200 lbs. per sq. in. Modulus of Elasticity, 1,600,000
Allowable Fiber Stress for W. Coast Hemlock—1040 lbs. per sq. in. Modulus of Elasticity, 1,400,000

Length of Span	Live Load in Pounds per Square Foot of Floor Area									
	10 lbs.		20 lbs.		30 lbs.		40 lbs.		50 lbs.	
	Nominal Size of Joist Required									
	Douglas Fir	W. Coast Hemlock	Douglas Fir	W. Coast Hemlock	Douglas Fir	W. Coast Hemlock	Douglas Fir	W. Coast Hemlock	Douglas Fir	W. Coast Hemlock
8′ or less	**2x6 in.**	**2x6 in.**	**2x6 in.**	**2x6 in.**	**2x6 in.**	**2x6 in.**	**2x6 in.**	**2x6 in.**	**2x6 in.**	**2x6 in.**
8′-6″	2x6	2x6	2x6	2x6	2x6	2x6	2x6	2x6	2x6	**2x8**
9′-0″	2x6	2x6	2x6	2x6	2x6	2x6	2x6	**2x8**	**2x8**	2x8
9′-6″	2x6	2x6	2x6	2x6	2x6	**2x8**	**2x8**	2x8	2x8	2x8
10′-0″	2x6	2x6	2x6	2x6	**2x8**	2x8	2x8	2x8	2x8	2x8
10′-6″	2x6	2x6	**2x8**	**2x8**	2x8	2x8	2x8	2x8	2x8	2x8
11′-0″	2x6	2x6	2x8	2x8	2x8	2x8	2x8	2x8	2x8	2x8
11′-6″	2x6	**2x8**	2x8	2x8	2x8	2x8	2x8	2x8	2x8	**2x10**
12′-0″	**2x8**	2x8	2x8	2x8	2x8	2x8	2x8	**2x10**	**2x10**	2x10
12′-6″	2x8	2x8	2x8	2x8	2x8	**2x10**	**2x10**	2x10	2x10	2x10
13′-0″	2x8	2x8	2x8	2x8	**2x10**	2x10	2x10	2x10	2x10	2x10
13′-6″	2x8	2x8	2x8	**2x10**	2x10	2x10	2x10	2x10	2x10	2x10
14′-0″	2x8	2x8	**2x10**	2x10	2x10	2x10	2x10	2x10	2x10	**2x12**
14′-6″	2x8	2x8	2x10	2x10	2x10	2x10	2x10	2x10	2x10	2x12
15′-0″	2x8	**2x10**	2x10	2x10	2x10	2x10	2x10	**2x12**	**2x12**	2x12
15′-6″	**2x10**	2x10	2x10	2x10	2x10	2x10	**2x12**	2x12	2x12	2x12
16′-0″	2x10	2x10	2x10	2x10	2x10	**2x12**	2x12	2x12	2x12	2x12
16′-6″	2x10	2x10	2x10	2x10	**2x12**	2x12	2x12	2x12	2x12	2x12
17′-0″	2x10	2x10	2x10	**2x12**	2x12	2x12	2x12	2x12	2x12	
17′-6″	2x10	2x10	2x10	2x12	2x12	2x12	2x12	2x12	2x12	
18′-0″	2x10	2x10	**2x12**	2x12	2x12	2x12	2x12			
18′-6″	2x10	2x10	2x12	2x12	2x12	2x12				
19′-0″	2x10	**2x12**	2x12	2x12	2x12					
19′-6″	**2x12**	2x12	2x12	2x12	2x12					
20′-0″	2x12	2x12	2x12	2x12						

Note—2x4 in. Douglas Fir may be used for ceiling joist (having no live load) up to 10-ft. spans. 2x4-in. West Coast Hemlock may be used for ceiling joist (having no live load) up to 9 ft. 6-in. spans.

Reference—Page 57, Bulletin No. 145, National Committee on Wood Utilization, U. S. Department of Commerce, "Light Frame House Construction."

THE FLOOR JOISTS

Joists are those members which actually carry the floors or ceilings between supports. The standard length of wood lath, which is commonly 4 feet, determines the spacing of the joists. In order to avoid excessive cutting of wood lath, joists should be spaced to fit the lath. This limits the spacing to 12, 16 or 24 inches. As 24 inches are too great in most instances for proper stiffness, 16 inches have become the standard spacing for joists and studs.

The joist sizes are dependent upon the length of the span they bridge and upon the load they are required to carry. Failure to use joists of sufficient size is sometimes the cause of sagging, squeaky floors, rattling light fixtures, and cracked ceilings below.

The table above is self-explanatory. It is advisable to use a live load of 40 pounds per square foot.

It is advisable to oversize the floor joists. By doing so, the whole building will be much stronger and stiffer, while the increase in cost will be very small. It is considered an excellent investment.

STANDARD DETAILS FOR HOUSE FRAMING

On the following five pages there are standard details for house framing shown. Practically every common detail in framing construction will be found on these exceedingly interesting pages. The pictures are more or less self-explanatory.

Without doubt, much carpentry has been carried on by the rule-of-thumb method. By means of the information given in this chapter, the carpenter can go ahead with his work, determining his methods on the information contained here, and be assured that his work will be satisfactory.

Many construction details are shown so simply in order that the layman can understand them. Study, for instance, the first three pictures that give the major framing systems: the Balloon Frame, the Braced Frame, and the Platform Frame. Further framings around openings and under bathrooms are given, as well as various floor-joist assemblies. There are also shown roof and dormer framings, framings for stairways, various types of bracings, etc.

STANDARD DETAILS FOR HOUSE FRAMING

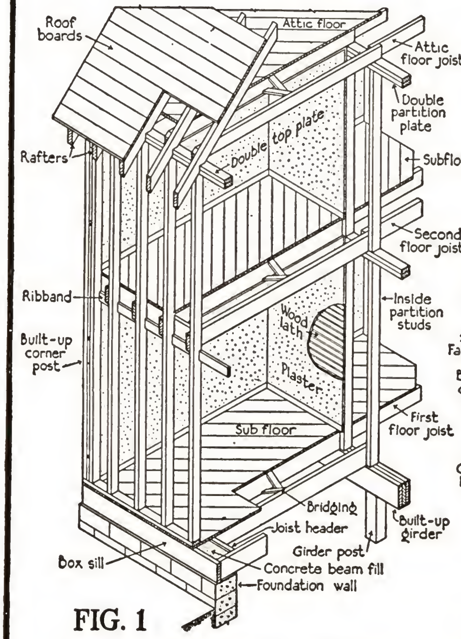


FIG. 1

THE BALLOON FRAME

This type of frame has many things to recommend it. The one piece studs, extending the full height of the wall and tied together by the ribband at the second floor line reduce to a minimum the shrinkage factor. It is strong and rigid but requires careful fire stopping.

This frame is more efficient when the interior studding is set directly on top of girders or bearing partitions.

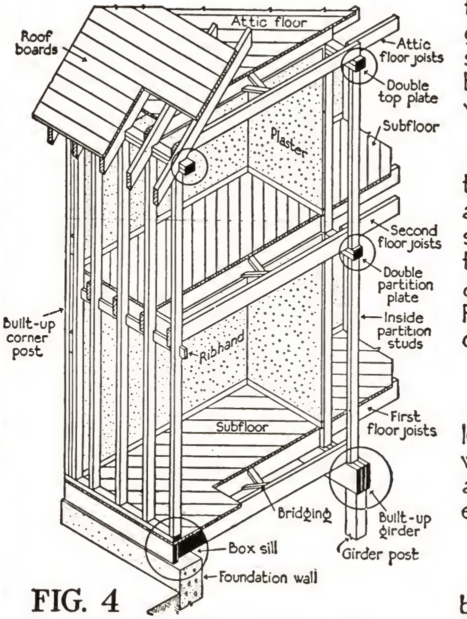


FIG. 4

DETAIL OF METHOD FOR SECURING BALANCED SHRINKAGE

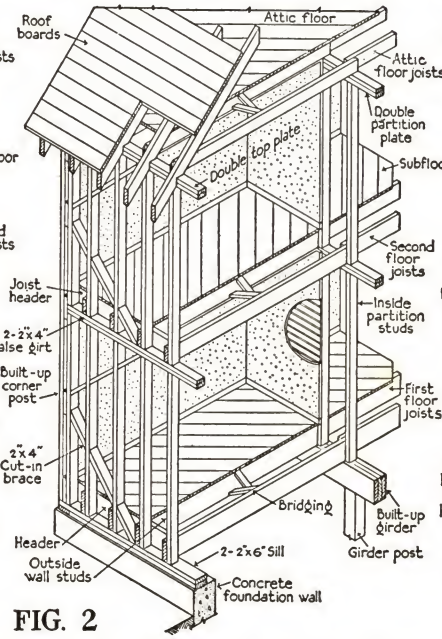


FIG. 2

THE MODERN BRACED FRAME

This type of frame is an outgrowth of New England solid timber post and girth construction. Built-up members are used today very largely and with equal satisfaction. Instead of heavy posts set eight or ten feet apart, walls are built with 2x4 in. studs set 16 in. on centers. The second floor is carried on a double 2x4 in girt. Diagonal bracing is inserted at the corners. This type has several commendable features. It is simple to build and has good provision for fire stopping both at sill and second floor line. 2x4 in. cut-in bracing, as illustrated, may also be used with other types.

~

THE FRAME provides the network to which the other materials are fastened and the strength and rigidity required to support the loads put upon it and preserve the materials with which it is built. Three distinct types of frames are shown by Figs. 1, 2 and 3. Numerous combinations of these types are frequently employed.

BALANCED SHRINKAGE

The total thickness of horizontal lumber in the framing of outside and inside walls on each floor should be equalized as nearly as possible to eliminate uneven shrinkage.

FIRE STOPPING

Fire safety in a dwelling is increased by preventing the circulation of air in the walls between floors or between rooms. An effective method is shown in the drawing to the right. (Fig. 5)

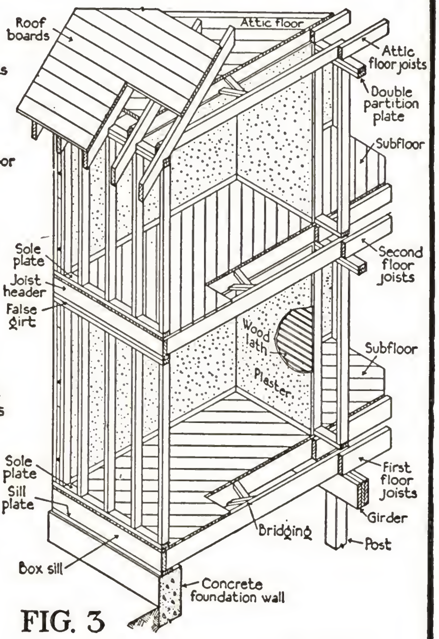
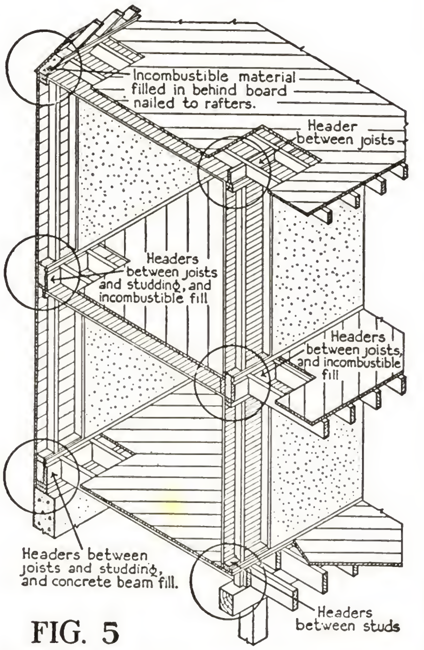


FIG. 3

THE PLATFORM FRAME

The Platform Frame is extensively used. It is similar in principle to Braced Frame but has boxed sill construction at each floor line. This makes for greater shrinkage but it is equalized on each floor when a similar type of construction is used under bearing partitions.

This frame is more efficient when the interior studding is set directly on top of girders or bearing partitions.



Incombustible material filled in behind board nailed to rafters.
Header between joists
Headers between joists and studding, and incombustible fill
Headers between joists, and incombustible fill
Headers between joists and studding, and concrete beam fill.
Headers between studs

FIG. 5

FRAMING FOR FIRE STOPPING

STANDARD DETAILS FOR HOUSE FRAMING

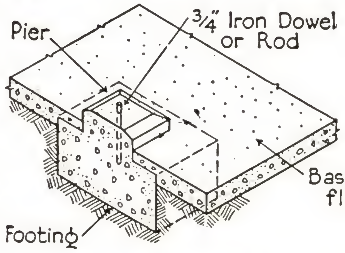


FIG. 6 FOOTING FOR COLUMN

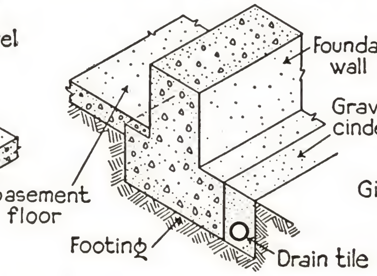


FIG. 7 FOOTING FOR FOUNDATION WALL

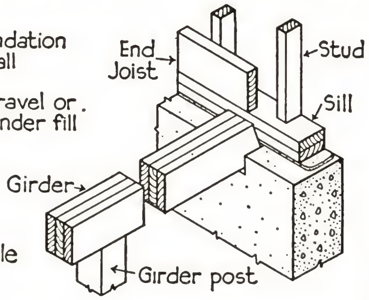
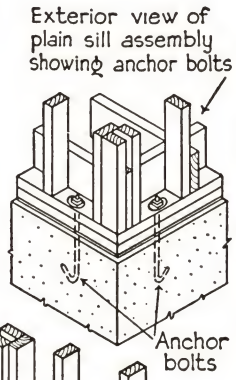


FIG. 8 BUILT-UP GIRDER-END SET IN CONCRETE WALL



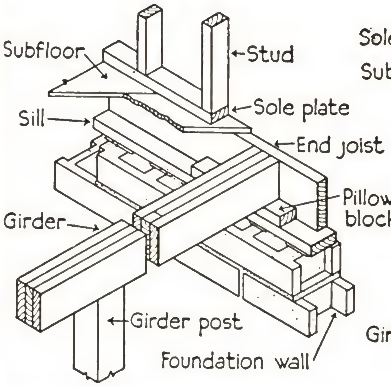


FIG. 9 BUILT-UP GIRDER END SET ON SILL PLATE

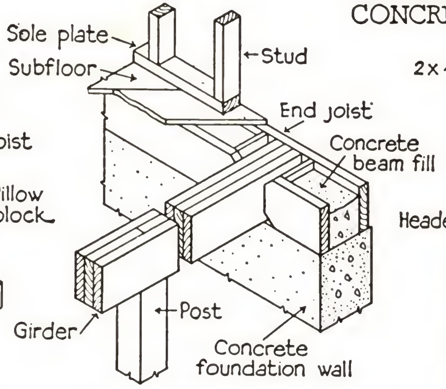


FIG. 10 BUILT-UP GIRDER END SET ON CONCRETE WALL

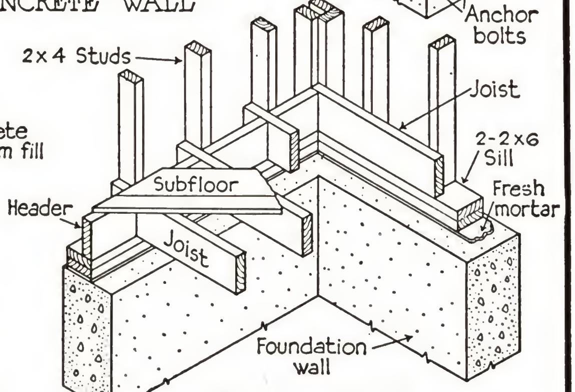


FIG. 11 PLAIN SILL ASSEMBLY

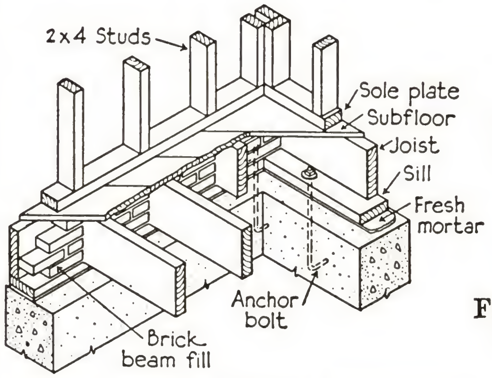


FIG. 12 BOX SILL ASSEMBLY WITH SILL PLATE

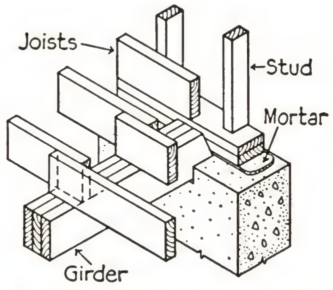


FIG. 14 FRAMING JOIST ON TOP OF GIRDER

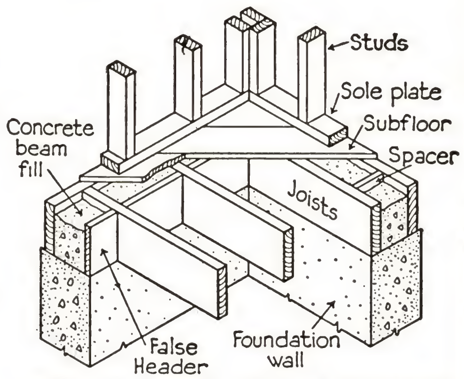


FIG. 13 BOX SILL ASSEMBLY WITHOUT SILL PLATE

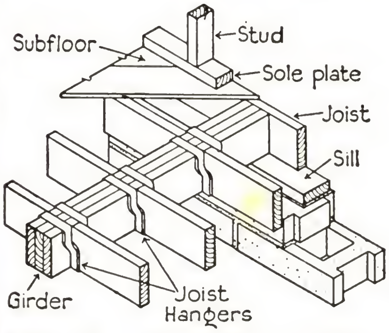


FIG. 15 FRAMING JOIST LEVEL WITH TOP OF GIRDER

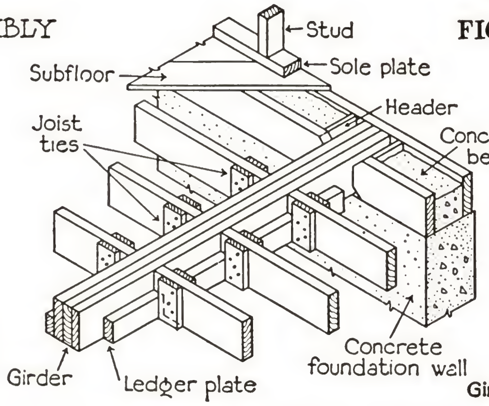


FIG. 16 FRAMING JOIST NOTCHED OVER LEDGER STRIP

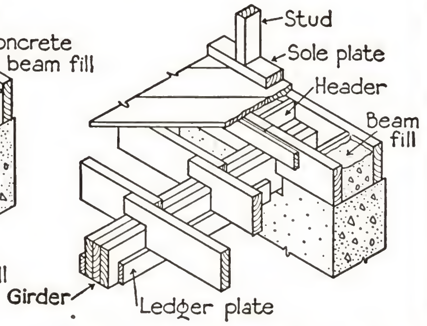


FIG 17 FRAMING JOIST NOTCHED OVER GIRDER

STANDARD DETAILS FOR HOUSE FRAMING

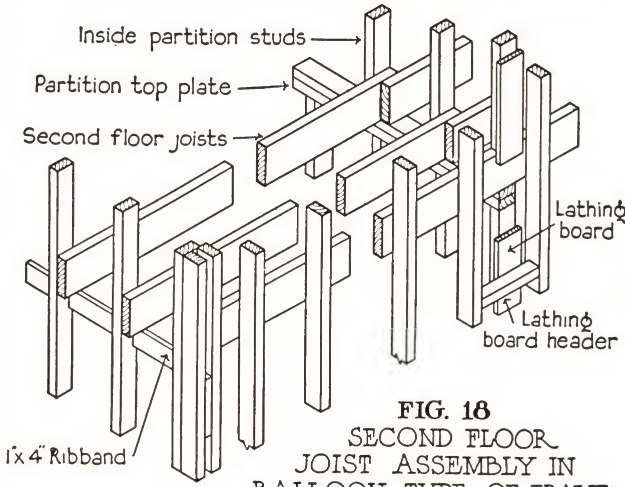


FIG. 18
SECOND FLOOR
JOIST ASSEMBLY IN
BALLOON TYPE OF FRAME

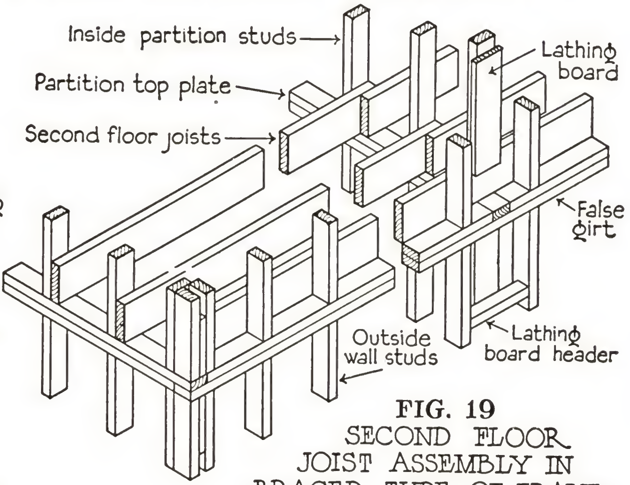


FIG. 19
SECOND FLOOR
JOIST ASSEMBLY IN
BRACED TYPE OF FRAME

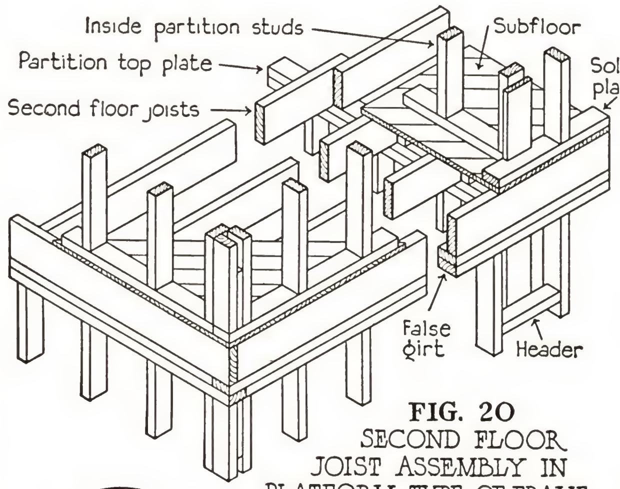


FIG. 20
SECOND FLOOR
JOIST ASSEMBLY IN
PLATFORM TYPE OF FRAME

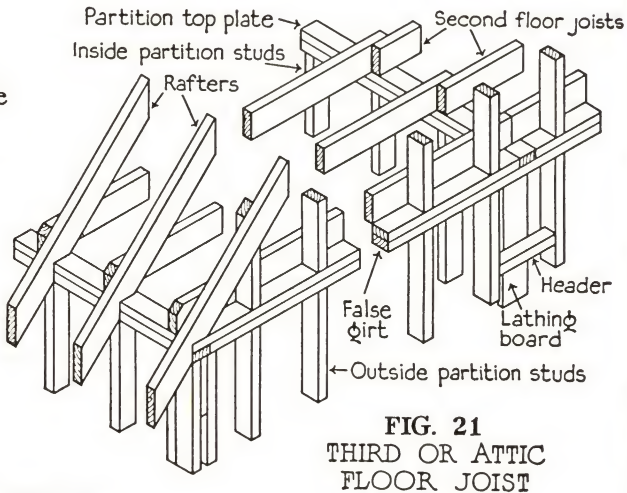


FIG. 21
THIRD OR ATTIC
FLOOR JOIST
ASSEMBLY

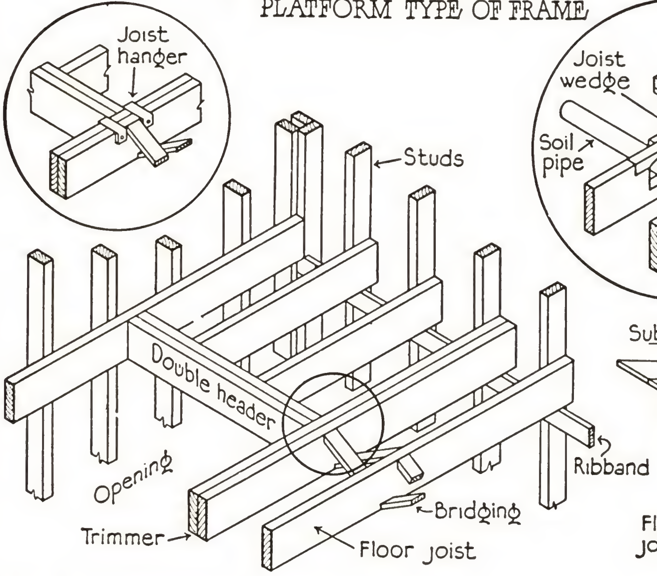


FIG 22 FRAMING AROUND FLOOR OPENING

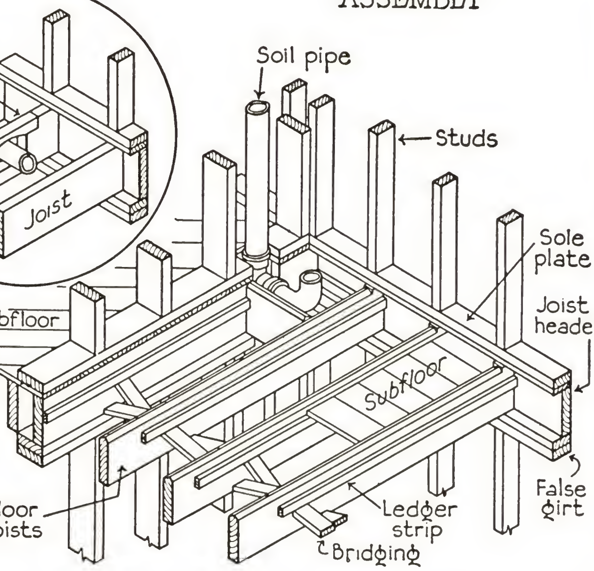


FIG. 23 FRAMING JOIST UNDER BATHROOM

STANDARD DETAILS FOR HOUSE FRAMING

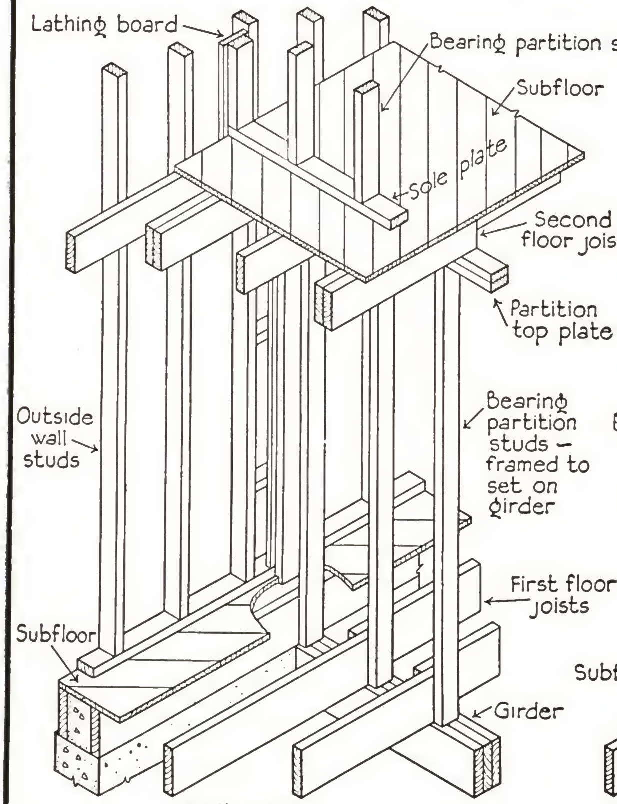


FIG. 25
FRAMING FOR BEARING PARTITION

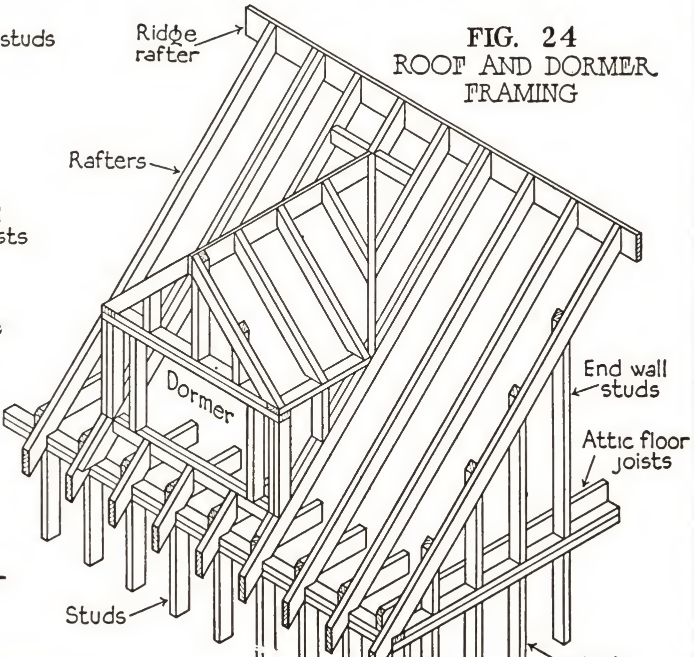


FIG. 24
ROOF AND DORMER FRAMING

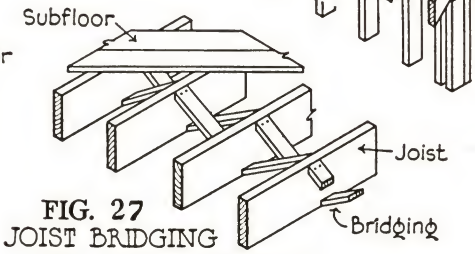


FIG. 27
JOIST BRIDGING

Note: Bridging should be nailed at top only until after subflooring is laid.

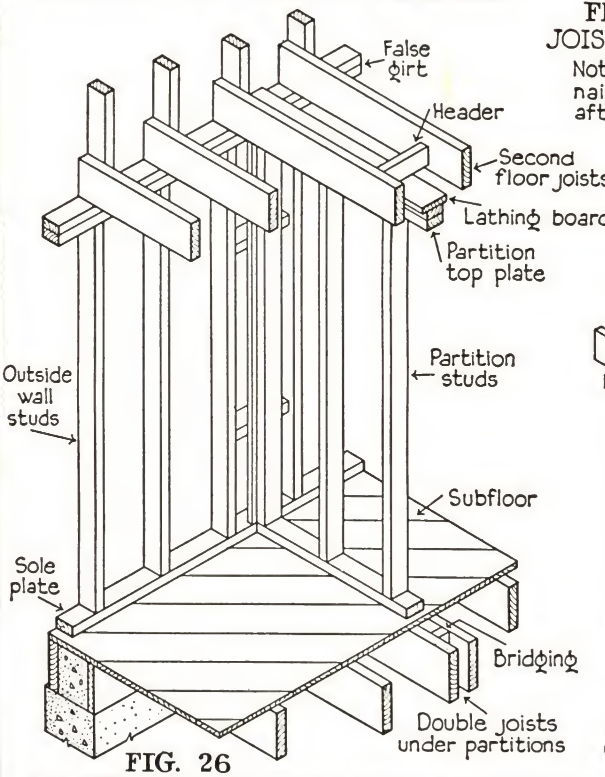


FIG. 26
FRAMING FOR NON-BEARING PARTITION

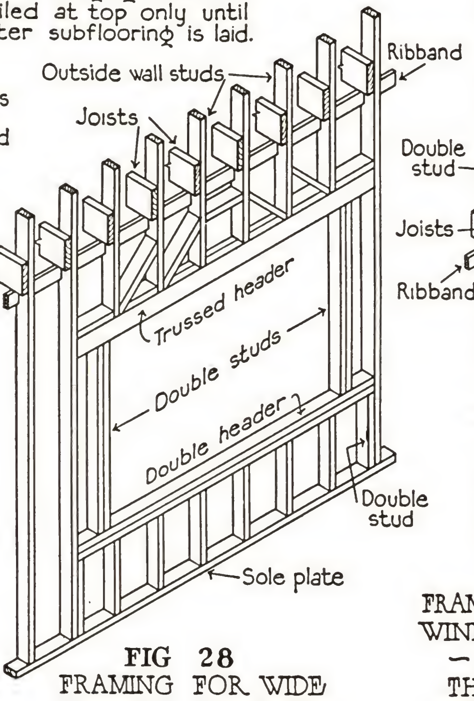


FIG 28
FRAMING FOR WIDE WINDOW OPENINGS

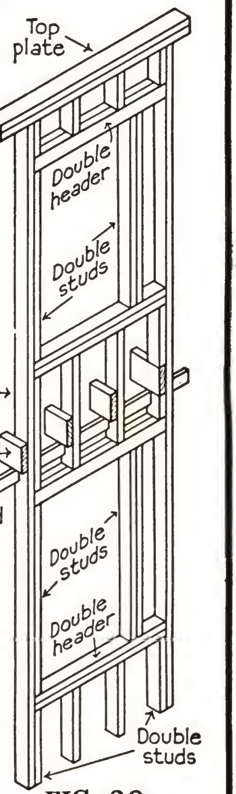


FIG. 29
FRAMING FOR TWO WINDOW OPENINGS — ONE ABOVE THE OTHER IN BEARING WALL

STANDARD DETAILS FOR HOUSE FRAMING

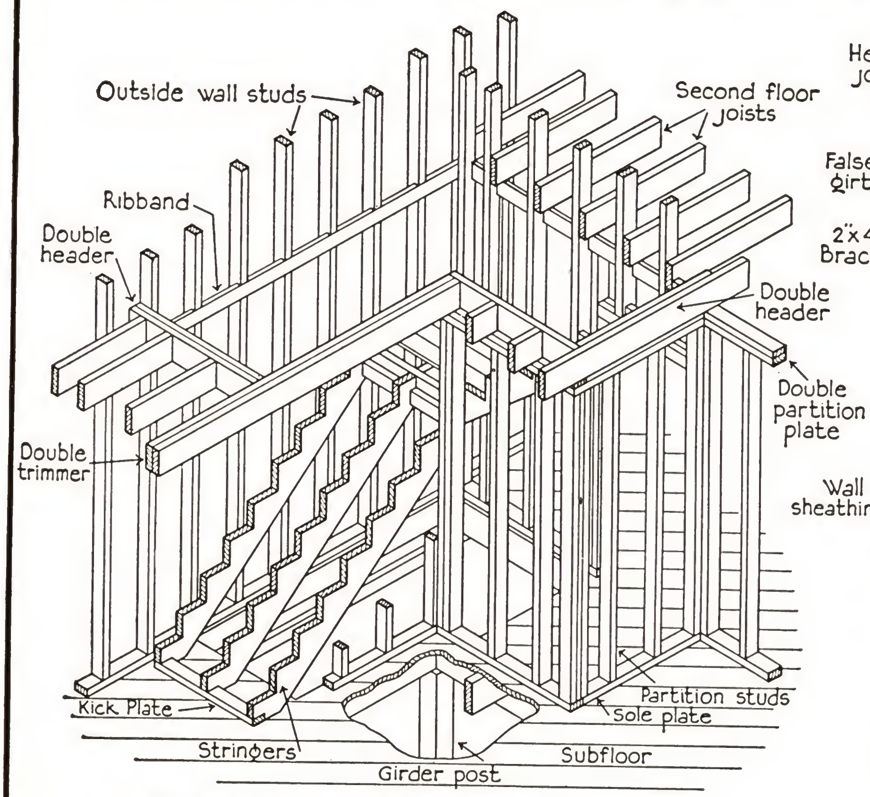


FIG. 30 FRAMING FOR OPEN STAIRWAY

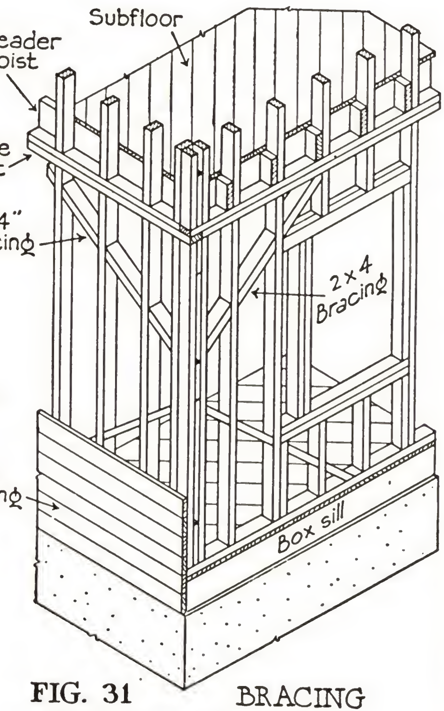


FIG. 31 BRACING
2"x4" Cut between studs
Sheathing applied horizontally

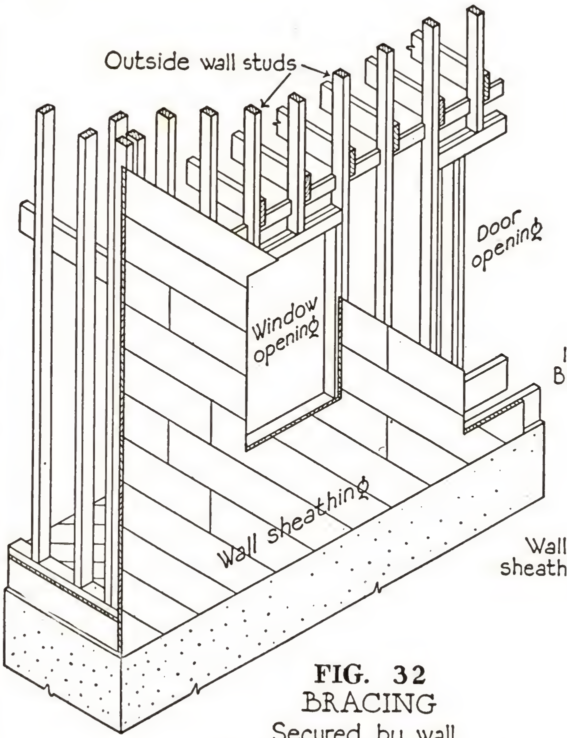


FIG. 32
BRACING
Secured by wall
sheathing applied diagonally

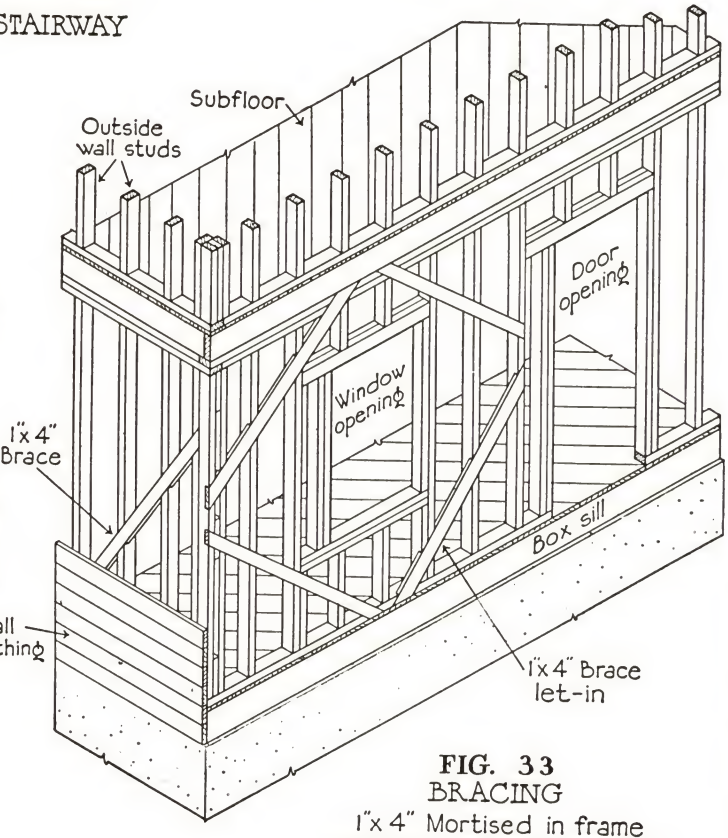


FIG. 33
BRACING
1"x4" Mortised in frame
Sheathing applied horizontally

BRICK CONSTRUCTION

By J. H. HANSEN Executive Secretary
Brick Manufacturers' Association of N. Y.

● IT HAS BEEN the custom to call a house a "brick house" if it has only 4 inches of brick veneer, or, at best, an 8-inch brick wall, with complete disregard to the floor construction. Since a new type brick floor has been developed, it is now possible to build a real brick house, where not only the walls but also the floors are of brick, as described in this article.

THE STORY OF BRICK. In 1628, just eight years after the Pilgrims landed at Plymouth Rock, bricks were being manufactured along the Hudson River. Possibly ten years earlier they were being made in Virginia. In fact, the first shipload of settlers to arrive at Jamestown, according to the passenger list, carried several brickmakers. This is a story of all civilized countries. The story of brick is usually as old as the story of the country, and for a good reason. Our early colonists in Virginia found that their greatest enemy was not the Indian, but *fire*. The Indians could be managed and controlled, but time and time again the settlements were completely destroyed by fire. Within the first few years of the settlement of Jamestown, Va., the fort, the storehouse and all of the supplies it contained, as well as most of the other buildings in the settlement, were completely destroyed by a fire starting in a wooden chimney. Then, as now, brick was recognized as the greatest safeguard against fire, and laws were passed making it mandatory to use brick in the construction of chimneys. This regulation has developed to such an extent that in many communities of our country today only brick or other fireproof masonry materials can be used in the construction of a house.

COMPOSITION OF BRICK. The raw materials are clay or shale and, in some cases, a small quantity of coal dust and sand. The clay, usually dark gray in color, burns into the well-known red color because of the presence of decomposed rock.

TYPES OF BRICKS. The most important trade names originating from the manufacturing processes are:

Soft Mud Bricks—raw clay pressed into molds.

Stiff Mud Bricks—raw clay forced through orifice and cut into bricks.

Further descriptive names applying to one or both of the above types are:

Dry Press Bricks—relatively dry clay molded under high pressure.

Sand Molded Bricks—mold coated with sand to facilitate extraction.

Water Struck Bricks—mold wet with water to facilitate extraction.

Down-draft Bricks—burned with combustible gases traveling downward in kiln.

Up-draft Bricks—burned with combustible gases traveling upward in kiln.

End Cut Bricks—clay or shale cut off at ends in Stiff Mud Process.

Side Cut Bricks—clay or shale cut off at side in Stiff Mud Process.

Typical of the brick suitable for small-house construction are the Hudson River Valley Soft Mud, Sand Molded Bricks. They are made by mixing and aging raw clay with a small amount of coal dust to insure proper burning, molding under pressure into molds dusted with colored sand, drying for approximately one day over steam pipes, and then stacking in kilns, often twenty-five or thirty feet high, over small arches spaced four or five feet apart, through which oil or coal supplies the heat. Some kilns contain as many as two and one-half million bricks. The heat is applied until the entire mass is red hot, and then the bricks are allowed to cool. The burning takes from five to seven days and eight to ten days are required for the cooling off. The bricks are then ready for use.

There are many who confuse the terms "face brick" and "common brick", and well they may, since both terms are more or less meaningless. All well-burned bricks are face bricks. The term "common brick" is usually applied to bricks that are produced in your own locality and sold at a low price, that have not truly square corners or straight edges. If the price is such that the brick can economically be used for backing up, then the brick is frequently called a "common brick." Although the characteristics of the various bricks produced throughout the country will vary considerably, the quality is all the same insofar as serviceability for house construction is concerned. A well-burned brick, regardless of its appearance or the method of manufacture used, remains today the most durable building material known to the construction industry. Consequently, in selecting a brick you need only be concerned with its being well-burned and having an appearance to satisfy your particular taste.

SIZE OF COMMON BRICK. The American Society for Testing Materials and Federal Standards has set the size at 2¼″×3¾″×8″.

USE OF COMMON BRICK. Common brick today is used extensively in houses for either brick veneer with some other form of load-bearing backing or as a solid 8-inch brick wall. Its warm and informal appearance is particularly desirable in a residence. Veneering with brick is accomplished by laying them in the customary flat position, making a 4-inch veneer using 6.2 bricks per square foot, or they can be laid on edge to form a 2¼-inch veneer requiring 4 bricks per square foot. Solid 8-inch walls require 12.3 bricks per square foot.

The Brick Wall

The brick wall is built of any thickness in multiples of the brick width, laid in several different types of mortar. The usual thicknesses of 8 and 12 inches create walls with strengths far in excess of any load they are apt to be subjected to in a small house.

MORTAR COSTS are well worth watching. As a rule, a cubic foot of lime or mortar mix costs less than a cubic foot of cement and, consequently, should be used as much as possible, since the results are just as good, if not better. Note the difference in cost in the table below:

100 cubic feet of 1–3 Cement Mortar costs:

32 bags of cement at 66¢	$21.12
For workability, add:	
3 fifty lb. sacks of lime at 37¢	1.11
4 cubic yards of sand at $2.00	8.00
	$30.23

100 cubic feet of 1–1–6 Cement Lime Mortar costs:

18 bags of cement at 66¢	$11.88
14 fifty lb. sacks of lime at 37¢	5.18
4 cubic yards of sand at $2.00	8.00
	$25.06

Difference $5.17

This is a saving of about 20 per cent over the 1–3 mix. A large percentage of masonry work can be, and should be, built with mortar having an even greater per cent of lime, such as 1–2–9 by volume of cement, lime and sand.

BRICK MASONRY COSTS are affected by items such as the location and size of the job; wages paid; the efficiency of the workmen; the weather conditions; the type of work; the brick bond used; and the kind of mortar. There are some exaggerated ideas extant, however, concerning the actual cost of such construction. Let us analyze the cost of 100 square feet of some form of brick construction and compare it with other types, remembering that, because of the above variations, certain assumptions must be made.

LABOR COSTS include masons with helpers sufficient to mix all mortar and erect all scaffolds and keep a supply of bricks at hand. In solid brick construction one helper is usually sufficient for each mason. In veneer work the mason lays fewer bricks; therefore, one helper for every two masons is sufficient. In veneer work masons lay from 800 to 1,000 bricks per eight-hour day. In 8-inch solid brick walls from 1,000 to 1,200 bricks per day are laid. In estimating we will use 900 and 1,100 and wages of $12 for masons and $6.00 for helpers.

MATERIAL COSTS, using ½ inch joints of 1–1–6 mortar and headers every fifth course, are easily ascertained. In 8-inch solid brick construction 12.3 bricks per square foot and 1/6 cubic feet of mortar are required. Common brick can usually be purchased for $10 to $14 per thousand delivered. Scaffold costs on medium-sized residence construction can be estimated at $2.00 per thousand brick for solid 8-inch brick construction, and $4.00 per thousand brick for 4-inch veneer, and $5.00 per thousand brick for 2¼-inch veneer.

100 square feet of 8-inch Solid Brick Masonry costs:

1,230 common brick at $12 per thousand	$14.76
19 cubic feet of mortar at 25¢	4.75
$\frac{8\times1230}{1100}$ = 9.0 mason hours at $1.50	13.50
9.0 helper hours at 75¢	6.75
Scaffolds at $2.00 per thousand brick	2.46
Total Cost	$42.22

100 square feet of 4-inch Common Brick Veneer costs:

615 bricks at $12	$ 7.38
8 cubic feet of mortar at 25¢	2.00
$\frac{8\times615}{900}$ = 5.5 mason hours at $1.50	8.25
2.8 helper hours at 75¢	2.10
70 wall ties at $3.00 per hundred	2.10
Scaffolds at $4.00 per thousand brick	2.46
Total Cost	$24.29

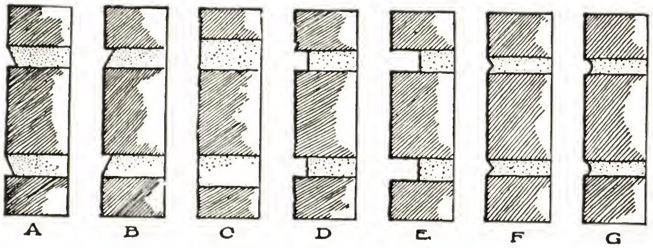
100 square feet of 2¼-inch Common Brick Veneer costs:

400 bricks at $12.00 per thousand	$4.80
3.2 cubic feet of mortar at 25¢	.80
$\frac{8\times400}{900}$ = 3.6 mason hours at $1.50	5.40
1.8 helper hours at 75¢	1.35
70 wall ties at $3.00 per hundred	2.10
Scaffolds at $5.00 per thousand brick	2.00
Total Cost	$16.45

Your own brick masonry contractor can undoubtedly reduce these conservative figures.

OUTSIDE FINISH. Common brick in its natural state makes a wall of appealing warmth and charm. Its appearance can be varied by the color of mortar, type of joint and bond, or by painting. Care should be taken to use only mineral pigments as mortar color. Cheap colorings often take the "life" out of the mortar.

THE TYPES OF JOINTS in common use are illustrated below—A, B and C being the most easily made. Choice is mainly a matter of taste. It should be remembered that about 30 per cent of the wall area consists of joints, so they should be well made. Type B is the best.

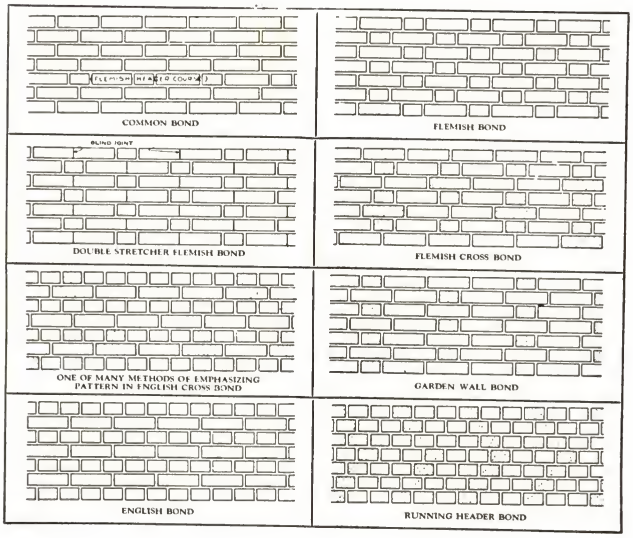


Common types of joints. (A) struck joint, (B) weathered joint, (C) flush or plain cut joint, (D) raked joint, (E) stripped joint, (F) "V" joint, (G) concave joint.

BRICK BONDS consist of many variations of two fundamental methods of placing the brick in the wall. These variations are brought about by the distribution of stretchers—brick laid with the length of the brick in the direction of the length of the wall—and headers—brick laid with the length of the brick across the wall—in any manner to create a desired pattern.

Some bonds, however, because of the care necessary in their laying, add considerably to the cost of the mason's labor. When brick of one general color are used, the type of bond is hardly noticeable, except when viewed from a very short distance. Consequently, the more common and simple types are usually recommended.

BONDS



Although the frequent use of headers is supposed to increase the strength of the wall by securely bonding it, a sufficient number of headers to satisfy most building codes is obtained by making every sixth course a header course. The more popular types of bonds are illustrated here.

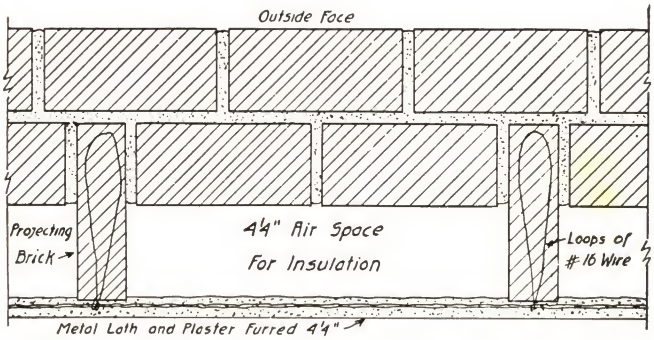
PAINTING OR WHITEWASHING BRICK should be done for only one reason: to secure a particular desired appearance. It is ridiculous to think that painting brick masonry preserves it, since there is no more durable material than brick and it will be there hundreds of years after the paint has worn away. Neither is paint of any value as a waterproofing agent.

Brick walls should be thoroughly dried out and cleaned of all dirt before painting is begun. It is best to wait two or three months after construction and after a dry spell before paint is applied. If it must be painted earlier, the walls should be brushed with a zinc-sulphate solution, consisting of 3½ lbs. of zinc-sulphate crystals to a gallon of water, after a thorough brushing. Oil paints may be applied in the customary manner, and two coats will generally prove satisfactory. The first coat should be allowed to dry for two days before the second is applied. Cement paints must be put on wet walls, in contrast to oil paints, which demand dry walls. In using cement paints care should be taken to see that each coat is kept damp 48 hours after application.

Whitewash of any of the numerous formulas may be applied cheaply and easily and creates a very desirable appearance. The cost of painting may be estimated from the fact that a gallon of oil paint will cover about 175 square feet of brick masonry for the first coat and 350 square feet for the second coat, and 5 lbs. of cement paint powder will cover about 200 square feet.

EFFLORESCENCE is the white scumming that is noticeable on red bricks. It consists of a deposit of crystallized salts of various kinds which, although they are most visible on the face of the brick, do not come from the brick. Only 10 or 15 per cent is traceable to the brick, and the rest comes from the water, sand, cement and lime that are used in the mortar, or from the various stone trims. To prevent efflorescence merely requires water being kept from entering the brick wall, because it is when water comes from the inside of the wall to the surface that it brings these salts out and deposits them. To prevent water from penetrating a brick wall all that is necessary is to secure completely filled mortar joints and to use an impervious flashing over all flat surfaces or projecting courses of brick, such as coping walls, window sills, and decorative features.

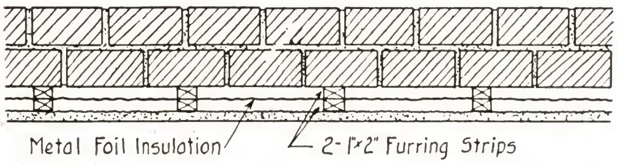
INSIDE FINISH. Frequently it is desired to eliminate plaster and paint directly on the inside surface of a solid brick wall. Although this has proved very successful, it has, in many cases, caused disappointment in climates where humidity is high and condensation on the inside of the wall results. Condensation, just as is noticeable on glass windows, is caused by the moisture in the warm room coming in contact with the cold surface of the glass or the wall and condensing. The function of furring strips is to prevent this condensation. The customary practice in furring is to erect 1″×2″ wood strips or steel furring strips 16 inches on center, on which is attached the lath and plaster. This creates a 1-inch airspace which not only prevents condensation but adds to the heat-resisting qualities of the wall. An economical method of furring a brick wall is illustrated in the figures below.



The 100 per cent fireproof brick wall. Projecting brick affords extra insulation.

In this method some of the bricks are allowed to project into the room any desired length, and wires placed in the mortar joints serve to tie the metal lath to the wall. In this manner furring is obtained at an extremely low cost.

Another method of furring which also provides an economical way of using metal-foil insulation with a brick wall is illustrated here. This consists of nailing directly into the brickwork the usual wood furring strip, over which are tacked the sheets of metal-foil insulation, and then nailing to the first set another set of furring strips, across which the lath and plaster are applied, thus supplying two airspaces divided by good insulating material. It is recommended, however, that before insulating a brick wall the chapters on heat transmission of walls in another part of this book be studied. The heat-resisting qualities of a common brick wall are such that insulation is really not necessary. Whereas it is economical to insulate other types of walls, it is frequently an extravagance on common brick masonry.



8-inch brick wall with foil insulation and a double set of furring strips.

INSULATING THE BRICK WALL. Those who have lived in a solid brick house have noticed that the heat of a hot summer day does not penetrate into the house. This is because the 8 or 12 inches of brick serve as a vast reservoir which can easily store up the heat transmitted to it by the sun during the day, and then, as night comes on, this mass of brickwork is cooled by the night air. It is the bulk and thickness of the brick wall that serve as a reservoir; this cannot be done by relatively thin layers of insulation. For this and other reasons the necessity of insulating a brick wall is not nearly so great as the necessity of insulating other types of walls; and whereas theoretical calculations will show that 4 inches of insulation pay big dividends when used in connection with other types of walls, no one should use more than 2 inches of insulation with an 8-inch brick wall.

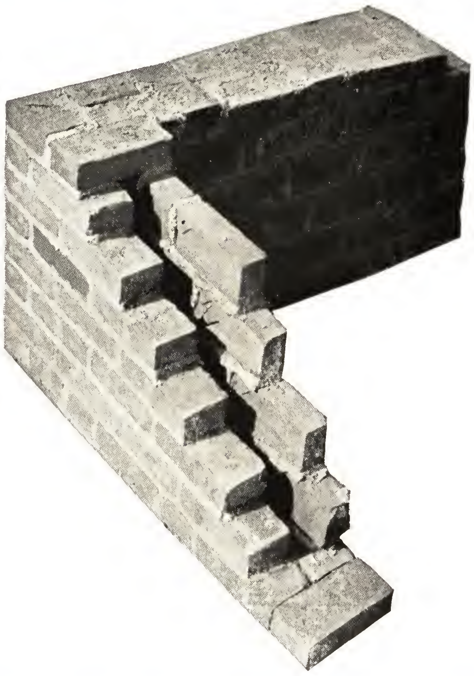
BUILDING GOOD BRICK MASONRY. No wall is as easily built as a brick masonry wall. No special care that does not come under the heading of common sense is required. Once it is up and in place, its factor of safety, both in strength and other requirements, is so great that it is not necessary to go into details as to how it is constructed.

Consequently, a detailed specification for brick masonry in small-house construction, although illuminating, is not necessary. Our recommendations, however, are to start with the locally made brick, as it is easily the most economical because of low transportation costs. Use a clean sand in a mortar rich in lime and, by preference, slaked lime. If the brick is of the more desirable absorbent type, have it thoroughly wetted before laying and every joint crammed full of mortar. *A wall with completely filled joints, and well-tooled joints, will not leak.* The use of proper flashing at all points where there is danger of water collecting on a surface, and keeping the wall covered during construction when it rains are equally important items. If these simple rules are followed, the walls of your house will be eminently satisfactory, will be indestructible, and will have absolutely no maintenance and upkeep costs. The first cost is the whole cost, whether you be visited by snow, sleet, rain or fire.

ECONOMY WALLS

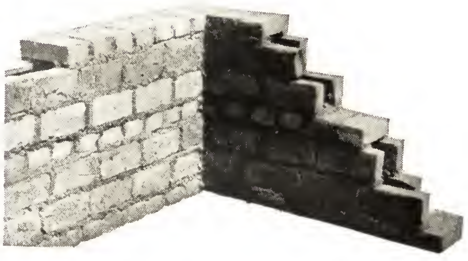
SPECIAL TYPES OF BRICK WALLS, SUCH AS HOLLOW WALLS, although not so well known as the solid wall, are excellent forms of construction where airspaces are desired for pipe shafts or any other purpose. They obviously require less material than solid construction, and masons soon learn to build them more rapidly. Their load-carrying capacity is more than sufficient for most types of buildings. The airspaces can be filled with

THE 8″ ROLOK-BAK WALL



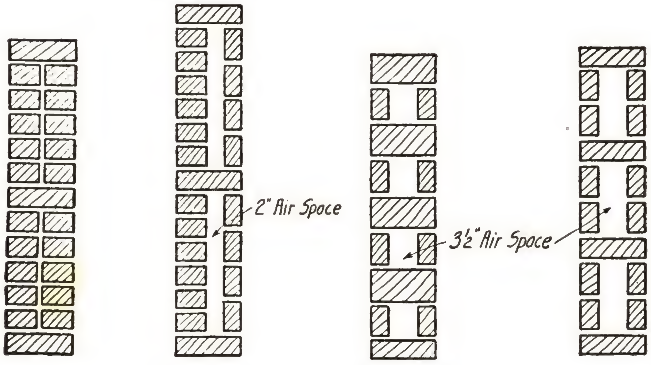
Six courses of the outside 4″ withe are first laid, backing up with the inside withe of brick on edge, and the continuous header course of brick laid flat is next placed.

THE 8″ ALL-ROLOK WALL



Note the simplicity of this sturdy wall—two continuous courses of stretchers, front and back, followed by the header course.

insulating or soundproofing material in bulk or sheet form. Walls of this nature have been in use for over a hundred years in England, and there are many examples in this country that have apparently given excellent service. As shown in the figure, the airspace is almost continuous and the only material that extends through the entire thickness of the wall is the brick in the header course. It is almost impossible for moisture to penetrate a wall of this type because, according to tests conducted at the U. S. Bureau of Standards, it is practically a physical impossibility for the vertical face of a wall to become so wet as to allow the moisture to travel through 8 inches of clay brick. This is especially true when the 8 inches of brick are surrounded by an airspace which allows the moisture to drop off or dry out of the brick. Such a wall, then, furnishes an insulation or airspace of 2 inches to 3½ inches without subtracting from the room space. There are nine variations of this type of wall; in Rolok-Bak only the back of the brick is laid on edge, and in All-Rolok all except the header brick are laid on edge. The three most suitable for house construction are shown in the figure below. Of these, the Rolok-Bak is, undoubtedly, the best for three reasons. First, the outside appearance is exactly the same as a solid brick wall. Secondly, the airspace prohibits the passage of moisture or water through faulty joints. Thirdly, the larger unbroken airspace is better adapted to insulation.



8″ Solid *8″ Rolok-Bak* *8″ All-Rolok in Flemish Bond* *8″ All-Rolok*

Construction details and material quantities vary somewhat with each adaption, but a cost analysis of two types will illustrate the economy effected by all of them.

The 8-inch Rolok-Bak wall requires 7 exposed and 3½ backing bricks per square foot, making a total of 10½ bricks and about 1/10 cubic foot of mortar. Masons lay about 90 square feet—950 bricks—per day, with two helpers for every three masons.

100 square feet of 8-inch Rolok-Bak wall costs:

1,050 common brick at \$12 per thousand	\$12.60
11 cubic feet of mortar at 25¢	2.75
$\frac{8\times 100}{90}$ = 8.9 mason hours at \$1.50	13.35
$\frac{2\times 8.9}{3}$ = 5.9 helper hours at 75¢	4.42
Scaffolds at \$2.50 per thousand brick	2.64
Total Cost	\$35.76

Eight-inch All-Rolok walls require only 9 bricks per square foot and about 1/7 cubic foot of mortar. Masons will lay about 100 square feet—900 bricks per day—with two helpers for each mason.

100 square feet of 8-inch All-Rolok wall costs:

900 brick at $12 per thousand	$10.80
7½ cubic feet of mortar at 25¢	1.88
$\frac{8 \times 100}{100}$ = 8 mason hours at $1.50	12.00
$\frac{2 \times 8}{3}$ = 2⅔ helper hours at 75¢	2.00
Scaffolds at $2.50 per thousand brick	2.20
Total Cost	$28.88

These costs are approximately 25 per cent less than 8-inch solid brick construction and less than most walls considered for the "House of Health." They give you all the advantages of a hollow wall and most of the advantages of solid brick construction.

Obviously, therefore, the cost of brick construction is within the reach of home builders. It is inadvisable to get an estimate of brick construction from a contractor who specializes in other forms of construction, because he will not be familiar with all the details and his figure is likely to be misleading.

SOUNDPROOF ROLOK PARTITION WALLS

These partitions will greatly increase comfort and can be obtained at a very low cost. They are built of common clay brick laid on edge (Rolok) to form a core 2¼ inches thick. This is then plastered on both sides with ½ inch of lime plaster, making a total wall thickness of approximately 3¼ inches. Tests on this wall have proved that it is remarkably soundproof; its resistance to sound being such as to nullify almost completely the sounds of singing, loud talking or laughter, phonograph records, radio receiving sets, and all other normal objectionable noises. Its weight is only about twenty pounds per square foot, and it can be constructed at very low cost. Because of the small sections into which partition walls are cut, masons will only lay about 800 bricks per day, with one helper for every two masons. The wall requires four bricks per square foot and 1/30 cubic foot of mortar per square foot.

100 square feet of Soundproof Rolok Partition wall costs:

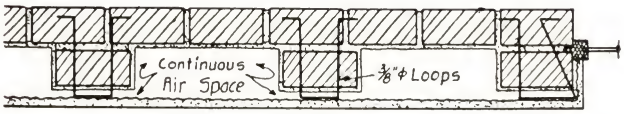
400 common brick at $12	$4.80
3.2 cubic feet of mortar at 25¢	.80
$\frac{8 \times 400}{500}$ = 3.6 mason hours at $1.50	5.40
$\frac{3.6}{2}$ = 1.8 helper hours at 75¢	1.35
Scaffolds for partitions nine feet high	.50
Total Cost	$12.85

This cost of $12.85 is the total cost of the actual partition. The finish of such a partition requires nothing more than plaster, which can be put on in two coats because the brick wall forms an admirable back for plaster. Consequently, the cost of plaster is only about six cents a square foot; which would bring the finished cost of 100 square feet of the above partition up to $24.85. If wood studs were used, both lath and plaster would be required as a finish and would cost approximately twelve cents per square foot each side, which, when added to the cost of the stud partition, would form a more expensive partition than the above-described fireproof, waterproof, Rolok partition.

The Brick Floor

WHEN the outside walls and the partitions are built of brick, and a brick floor is used, the structure of your house is about as durable and as safe from fire as it is possible for human beings to make it. A fireproof floor such as described here—a reinforced brick floor—will make your house a real brick house, and the greater stability of the house, by having all the walls tied together by steel, will insure against damage from hurricanes, etc.

It is possible to use this type of floor in connection with an economical 4-inch brick wall in which 8-inch brick piers are built to receive the ends of the steel beams. This is accomplished by building the 4-inch brick shell and placing on the inside, at the beam points, another brick, laid lengthwise and tied to the exterior 4 inches by means of metal rods, as illustrated here.



The ribbed brick wall.

This newly developed brick floor was tested under the direction of Odd Albert and Professor C. T. Schwarze at New York University. The tests were so successful that the New York City Board of Buildings approved this type of construction for residences for loads not to exceed 92 lbs. per square foot on interior spans not over 6 feet. The customary loading in small house construction is 40 lbs. per square foot, so it is obvious that it more than meets all the requirements for small-house construction.

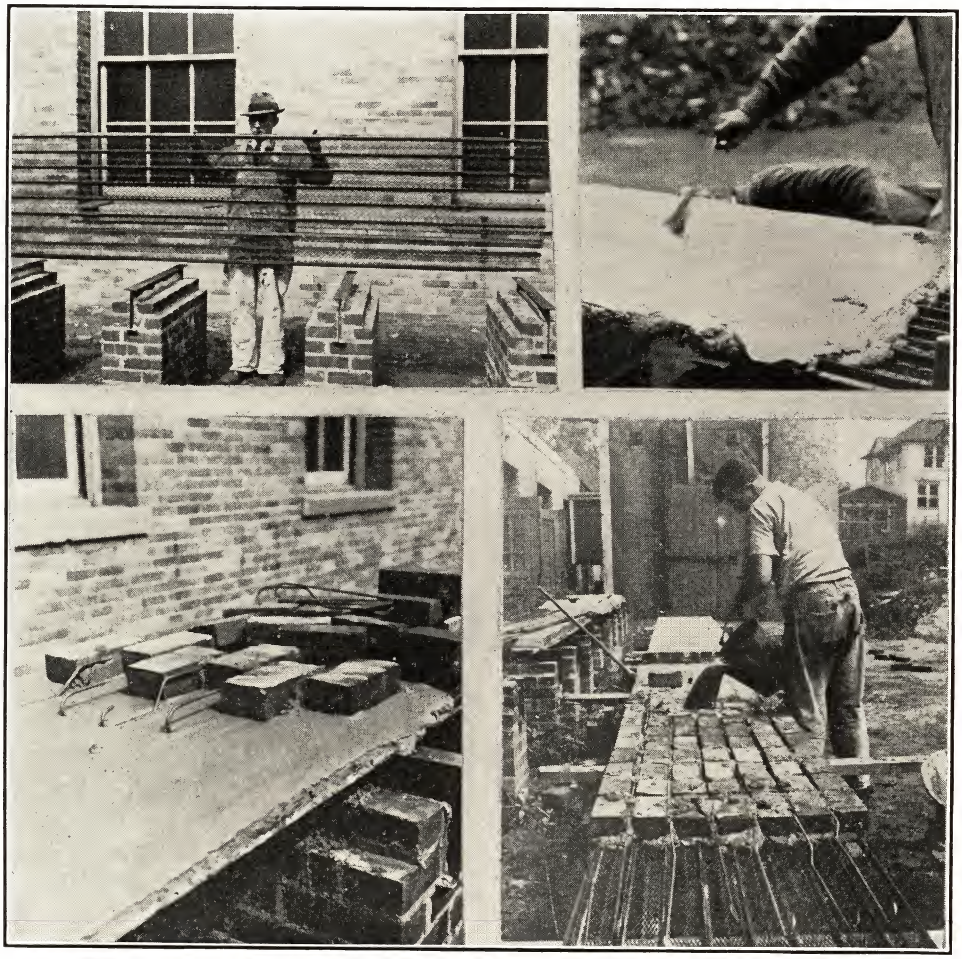
THE CONSTRUCTION consists of ribbed metal lath which serves as both form and positive reinforcement, which weighs .86 pounds per square foot, and which is easily laid across the bearing members, be they steel beams, concrete beams or load-bearing walls, as shown in picture below. When this is clipped into place a one-inch bed of stiff mortar is applied evenly. The brick are then laid flat on this mortar bed, spaced approximately ½ inch apart. The necessary ¼ inch negative reinforcing bars are then dropped into place between each row of brick, giving a spacing of 4¼ inches. A thin mortar grout is then poured between the brick, which finishes the floor. When hard, this floor may be polished and waxed, or covered with linoleum or wood on mastic.

THE FIRST TESTS ON SHORT SPANS were made at New York University in 1935, on 30-inch, 36-inch and 40-inch spans. Description of these tests was given in the *Engineering News Record* of August 22, 1935. In this series of tests only one slab could be broken. Failure occurred at a load equivalent to 1,120 lbs. per square foot, uniformly distributed. One of the other slabs was loaded with all the available material to a load equivalent to 2,140 lbs. per square foot, uniformly distributed, without failure or excessive deflection.

THE TESTS ON LONG SPANS were made in September, at the request of several prominent architects and engineers who witnessed the first series of tests. These consisted of 5-foot, 5-foot 6-inch, and 6-foot spans, of construction almost identical with that of the shorter spans—that is, the same metal lath, one course of brick laid flat, and the same type of rods, although longer, so as to lap in middle with hooked ends to form positive reinforcement.

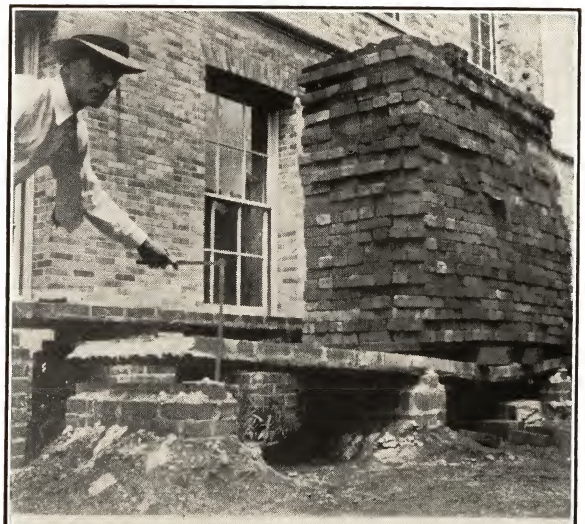
THE COST will average about 30 cents per square foot, including steel beams but excluding plaster. This means that a small 20′ by 30′ bungalow can have the advantage of a strong, permanent, termite-proof, fireproof floor at an increased cost of about 13 cents per square foot, or $78 total over a wooden floor. An added advantage of this floor in small-house construction is that it will add rigidity to the structure.

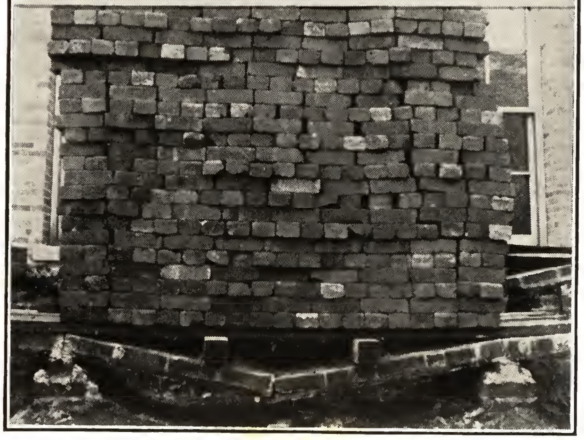
THE ADVANTAGES of this type of floor are that the materials required are easily obtainable in almost any section of the country, and almost any type of labor can build it without resort to expensive equipment. Laborers continue working up until the whistle blows, because the slab can be stopped at any point, without the necessity of building bulkheads, and the work continued the next day without any preliminary preparations.



THE CONSTRUCTION OF THE NEW TYPE BRICK FLOOR
The four major steps: Laying lath, spreading mortar bed, placing rods and pouring in grout.

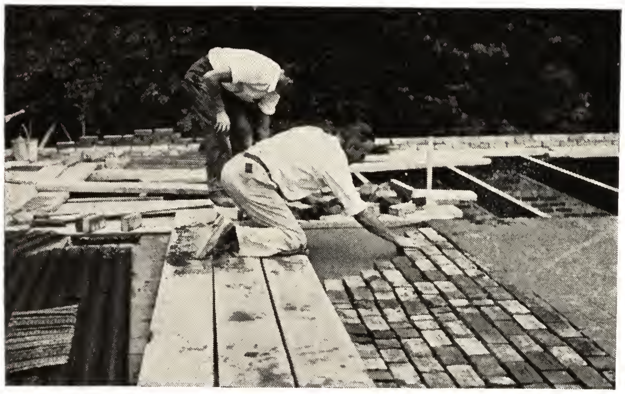
The load is now over 7000 pounds, showing uplift of unloaded ends.





Failure at a load of 8325 pounds applied in third-points.

It is expected that such an easily obtainable fireproof floor will find ready acceptance on the part of the small-house builders, especially since the slab itself can be waxed and polished to form a beautiful floor finish for those parts of the home where it would be desirable. The balance can be covered in the customary manner with wood or composition flooring. Actual construction of this type of floor in a house is shown in the photograph.



IN CONSIDERING THE COST OF A BRICK HOUSE these characteristics should be remembered:

1. The upkeep is extremely low, because no painting or repairs are required on the brick walls.
2. Termites and bugs, which annually destroy more than 40 million dollars worth of property, find no food in brick masonry.
3. When combined with fireproof floors and roofs, the lives of your family cannot be endangered by fire. The brick walls and chimneys are usually the only things seen standing after a fire has attacked a non-fireproof house.
4. It is the most permanent building material known to the construction industry, and therefore it gives to your house a high resale value.

Above: View of crowd watching tests.

Below: Inspector Sheehan (right) satisfied, and Engineer Odd Albert (left) happy. Test O.K. and over.

STRUCTURAL CLAY TILE in Modern Home Construction

● BUILDING a home is not only one of life's greatest pleasures, it is perhaps one of the most important things that men or women do in their lifetime. The majority of home builders will never be able to build more than one home and for such people it is necessary that the problem be given the most careful consideration. The house must be built right. It must be set in a suitable and healthful site. It must be pleasing and restful. It must be planned so that the cost of operation and upkeep is a minimum, and it must be built as economically as possible, consistent with good and efficient construction.

While low first cost is important for most of us, it should be remembered that too rigid economy in building may mean rapid deterioration and heavy maintenance cost in the future. Poor and shoddy construction does not pay in the long run. Better to put a few extra dollars into the house at the beginning than to have continual expense for repairs and upkeep later.

FOUNDATION AND EXTERIOR WALLS

The foundation and exterior walls are two of the most important parts of the house. No matter how well the interior may be planned and equipped with all the most modern conveniences, the house will be uncomfortable and unsatisfactory if the foundation settles or the exterior walls do not keep out the dampness and cold of winter and the heat of summer. The exterior walls should be fire resistant and built of materials which will stand the wear and tear of weather or attacks by termites, and which will not require frequent repair and painting.

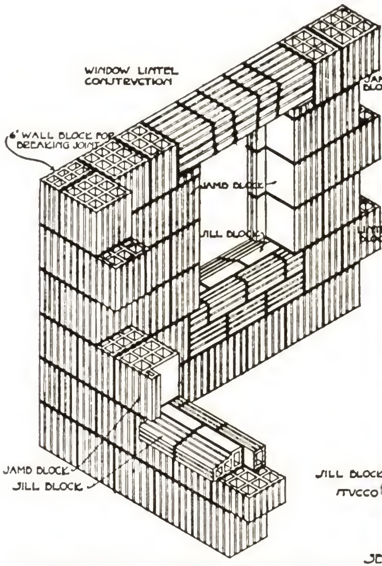
STRUCTURAL CLAY TILE IN HOME CONSTRUCTION

History has proven that burned clay is one of the most enduring of all materials, and structural clay tile is a burned clay product scientifically designed to meet definite requirements. It will not deteriorate or decay, shrink, sag or rust. It is absolutely fireproof and will not yield in physical composition to the harmful effects of weather or time. It has more than ample strength to carry all loads developed in foundation or exterior walls in house construction without additional supports. It is proof against vermin and attacks by termites to which wood is subject. The hollow cells provide a dead-air space which has high thermal resistance to the transmission of heat or cold.

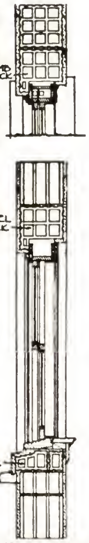
The use of structural clay tile affords endless opportunity for attractiveness and for simplicity and for individuality of structural outline in the outward appearance of the home. It makes possible a large range of artistic finish effects in color combinations of stucco, brick, terra cotta or stone, which are permanent and require no painting, renovating or replacing. The maintenance cost is reduced to a minimum.

BURNED CLAY

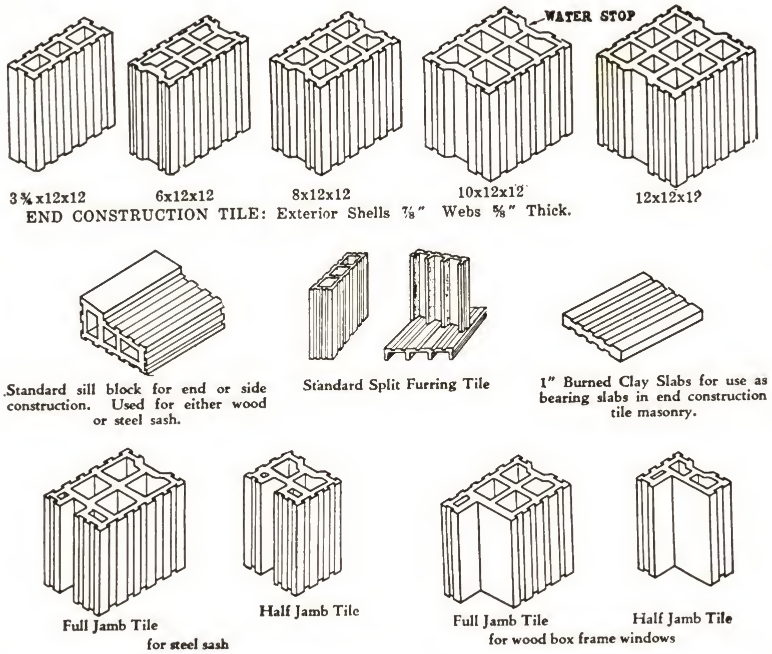
Burned clay was one of the earliest building materials used in ancient times. Both sun-dried and burned clay masonry materials were used, and walls were often faced with a fire-burned product to resist weather, backed up by the softer sun-dried clay masonry. For many centuries clay masonry units were made about the size of modern brick.



ISOMETRIC PERSPECTIVE OF 12" HOLLOW TILE WALL



SECTIONS SHOWING METHOD OF FITTING WINDOW FRAMES TO JAMB AND LINTEL BLOCKS



3¾x12x12 6x12x12 8x12x12 10x12x12 12x12x12

END CONSTRUCTION TILE: Exterior Shells ⅞" Webs ⅝" Thick.

Standard sill block for end or side construction. Used for either wood or steel sash.

Standard Split Furring Tile

1" Burned Clay Slabs for use as bearing slabs in end construction tile masonry.

Full Jamb Tile

Half Jamb Tile

for steel sash

Full Jamb Tile

Half Jamb Tile

for wood box frame windows

Standard shapes of load-bearing structural clay tile for hollow masonry walls available with either scored or smooth faces

Early attempts to make them larger failed because of the difficulty of burning large masses of solid clay without warping. About the middle of the eighteenth century, however, an Englishman found that larger units could be kept straight through the process of burning if a hole were put through them so that the mass would dry and burn from the inside and from the outside at the same time. This discovery resulted in the development of Structural Clay Tile, which has been closely allied with the advance of modern building in masonry walls and in the fireproofing field.

Structural Clay Tile is not a synthetic composition. Clay, from which it is made, is practically an indestructible basic material, provided by nature in abundant quantities and used from time immemorial. Science has provided many wonderful conveniences to lighten labor and add to comfort within the home, but science has invented no basic feature to compare with burned clay for the enclosing walls of a home or for use in foundations, floors, partitions, etc. Structural Clay Tile is a safe and economical building material.

THE USE OF STRUCTURAL CLAY TILE

For the average size house which is to be stuccoed it is recommended to use 8″×12″×12″ load-bearing tile blocks, which build a wall 8 inches thick. This wall is strong enough to carry a five-story house. These blocks are very light, as a large proportion of their volume is airspace, usually from 40 to 60 per cent of the gross volume.

Jamb tile, lintels, sills and fractional sizes are furnished where required to suit the particular design. Some of these shapes are shown on the first page of this article.

THE COST OF 100 SQUARE FEET OF 8-INCH HOLLOW TILE WALL

A good mason with one helper can lay 20 to 24 tile per hour. There are required 93 pieces 8″ × 12″ × 12″ load-bearing hollow tile and 3 cubic feet of mortar for each 100 square feet of wall area.

By estimating the cost, it is assumed that the mason and helper receive $1.50 and $0.75 per hour respectively, and that the cost of the blocks is $0.20 per piece.

Thus the cost per 100 square feet of wall will be:

93 load-bearing hollow tile, 8″×12″×12″, at $0.20	$18.60
3 cubic feet mortar, at $0.25	.75
4 mason hours, at $1.50	6.00
4 helper hours, at $0.75	3.00
Scaffolding	2.00
Total Cost	$30.35

APPROXIMATE PRICES

Prices given in this article should be used for approximate estimates only as they are based upon varying factors. Actual quantities of material have been used without waste and profit. The prices are also based on standard prices of materials and union rate of wages in effect within a radius of about fifty miles of New York City in 1937.

In estimating costs in different communities, the actual price of materials and wages for those communities should be used. Also, some allowance should be made in the quantity of materials for waste and profit, as these will vary with the class of workmanship. No builders' profits are included in prices given.

BRICK VENEER

Hollow tile is ideal for backing up brick-faced walls and for houses, 6″ Raritile is frequently used—which makes a wall 10″ thick. The cost per 100 sq. ft. is approximately as follows:

If common brick is used:

733 Common Brick @ $12.00	$8.80
140 6″ Raritile	15.75
17 cu. ft. of Mortar	4.25
Labor	20.00
	$48.80

Other types of combination tile and brick are also used. The Federal Housing Administration approves 8″ masonry walls built of 4″ of brick bonding with 4″ back-up tile. These walls are furred inside and finished with lath and plaster. Such walls compare favorably in cost with brick veneered wood frame houses.

STUCCO

Structural Clay Tile with its dovetail scoring provides an ideal base for stucco, eliminating the use of metal lath. Applied right, stucco will stand up indefinitely and will require no attention.

The approximate net cost of stucco applied on hollow tile is $0.11 per square foot.

THE INTERIOR FINISH

Though it is not necessary, it is recommended that exterior walls be furred out to receive plaster. For this purpose 1″ × 2″ wood furring strips 16″ on centers are used.

Today, when modern ideas require extra insulation, this may be accomplished by using the airspace between the wall and the inside plaster for storage of insulation material. In this case the furring space must be either 2 or 4 inches to make enough airspace. In these cases 1″ × 2″ or 1″ × 4″ wood strips spaced 16″ on centers are used.

The cost will be:

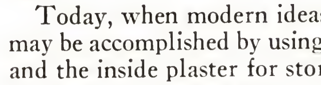
1″×2″ wood furring strips, 16″ on centers	$0.020 per sq. ft.
1″×4″ wood furring strips, 16″ on centers	0.028 per sq. ft.
Metal lath and plaster	0.12 per sq. ft.
Wood lath and plaster	0.10 per sq. ft.

THE COMPLETE FIREPROOF WALL

In order to completely eliminate wood in exterior wall, 2-inch partition tile may be used as illustrated below. By this construction the wall is completely fireproofed, and the construction is economical and substantial.

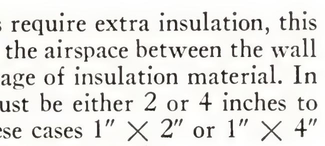
FIREPROOF STRUCTURAL CLAY TILE WALLS

Outside Finish—Stucco



Instead of wood furring strips 2″×10″ partition tile is used providing a 2″ air space. Thin insulation like aluminum foil may be used

Outside Finish—Brick



Instead of wood furring strips 2″×12″ partition tile is used providing a 4″ air space. Heavy insulation like Rock Wool may be used

THE ALL FIREPROOF HOUSE

It is no reflection on the intelligence of people unfamiliar with building materials and construction when they choose a house almost entirely from its architectural appeal, decorations, fittings and equipment. Frequently, a woman will be influenced in her final decision to purchase a house because she likes the layout of the kitchen, the bathroom fittings, or the color scheme. These are all very important, too, but of little avail if, underneath, the structure has not been built of good materials and workmanship. A house which may look like a million dollars when it is first finished will begin to look cheap and shoddy after a short time if the structural features are poor.

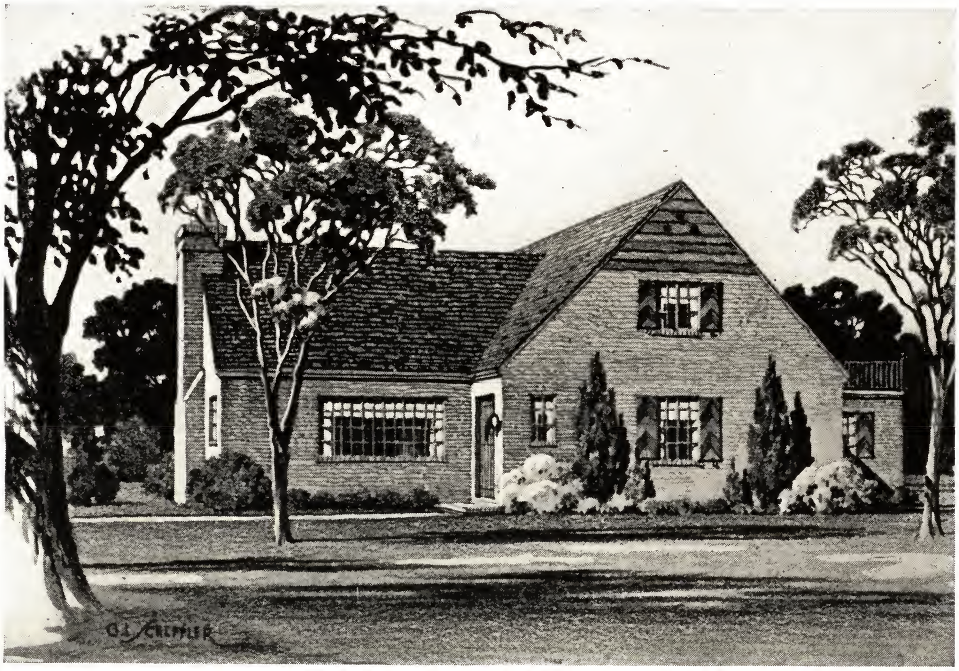
The attractive Structural Clay Tile fireproof house shown in the illustration is 100 per cent fireproof, and its cost is but little more than if it had been built of wood frame and ordinary materials. The walls, floors and roofs are fireproof, shrinkageproof, verminproof and termiteproof. It is solid, substantial and permanent. The upkeep and cost of insurance are low, and mortgage companies give such houses a high rating. These are important matters for consideration, aside from the more obvious advantages of better construction.

Frequently, house builders unfamiliar with fireproof construction endeavor to lower the cost by cheapening wall and floor construction. However, the cost of walls and floors of a house is only about 20 to 25 per cent of the total cost of a house; so that any savings effected by this means would be of minor consideration and very poor economy.

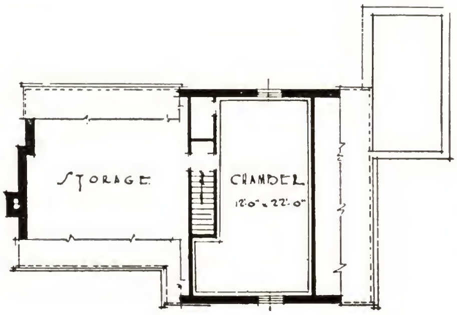
Take, for instance, the fireproof house shown in the illustration. The cost of fireproof walls and floors complete is only about $2,000; whereas the total cost of the house is about $8,000 complete with a fully equipped kitchen, oil burner and landscaping. The $2,000 covers all of the essential fireproof features of the house. The walls were built of hollow tile and stucco. The floors were built of precast hollow tile and reinforced concrete ribs, and the interior partitions were built of hollow partition tile.

The other $6,000 was put into features which would be the same no matter what the floors and walls were built of and included excavation and foundation; a fireproof insulated roof; plaster; staircase with solid oak treads; oak flooring; a bathroom fitted with the most up-to-date "Standard" colored fixtures with chromium fittings, plate-glass shower doors, colored tile walls and floors; an up-to-date kitchen with all steel kitchen cabinets, General Electric range, refrigerator, garbage grinder, dishwasher, etc., and linoleum on the floor—all ready for the housewife to move in and start dinner; automatic oil furnace; Monel-metal hot-water tank and all-copper water pipes; steel sash throughout and decorative shutters on all outside windows; millwork; trim; electric wiring; fixtures; painting; landscaping, etc.

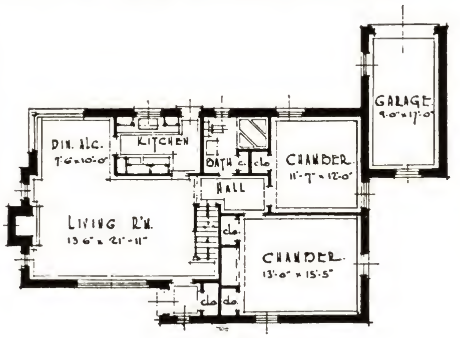
If this house had been built of the ordinary wood-frame construction with metal lath and stucco on the outside, the saving would have been only about $250, which is only about 3 per cent of the total cost. This $250 will soon be saved on the cost of upkeep as there will be little or no upkeep expenses. Structural Clay Tile will positively not expand when wet or shrink when dried out, causing unsightly cracks in plaster or stucco, and there is no metal



MODEL HOUSE—*Fred J. Burmeister, Architect. Ringhoff and English, Builders*



Second Floor



First Floor

lath required as a base for the stucco to rust out from the penetration of moisture. The lucky owner of this house need have no fear of fire, rapid deterioration, excessive expense for repairs, etc.—to say nothing of high depreciation. In twenty years the structural features of this house will be as good as they are today.

Further details, together with the actual cost of the fireproof construction in the house shown in the illustration, are given below.

The cost of foundation, basement, roof, plumbing, heating, fireplaces, electric wiring, finished flooring, kitchen equipment, windows, doors, trim, and other appurtenances common to all types of houses will be exactly the same. The only difference in cost is the difference between the cost of fireproof walls and floors and ordinary wood construction. For the Ringhoff and English Model House this difference in cost would be as follows:

	Fireproof Construction	*Nonfireproof Wood Construction*
1st Floor—Ready for finish flooring	$ 276.00	$ 220.00
2nd Floor—Ready for finish flooring (including garage roof)	333.00	256.00
Exterior walls with stucco and interior partitions ready for plaster	1352.00	1234.00
	$1961.00	$1710.00

These figures for fireproof construction include first and second fireproof floor slabs built of precast hollow tile and reinforced concrete ribs ready for the oak flooring, all exterior fireproof walls of 8-inch hollow tile and stucco with waterproof flashing, and all hollow tile interior fireproof partitions ready for plaster. All other features of the house will be the same for any other type of construction.

The figures for nonfireproof wood construction include wood joists covered with 1-inch sheathing and paper ready for oak flooring; all exterior walls of wood studding, sheathing, paper, metal lath and stucco with the interior surfaces lathed ready for plaster; and all interior partitions with wood studs, lathed ready for plaster.

From the above, it will be noted that the actual cost of fireproof floors, walls and partitions, including stucco on the outside walls, is only about $250 more than nonfireproof construction, which represents only about 3 per cent of the total cost of the house, including kitchen equipment, oil burner, landscaping, etc.

The builders of the model house shown in this article were so well pleased with the favorable reception it was accorded by the public that they have since built up an entire block on both sides of the street, at St. Albans, L. I., with the same types of houses and several more at East Williston, L. I.

JOISTILE SLABS—A New Type of Hollow Tile Floor

JOISTILE SLABS developed by engineers of the Eastern Structural Clay Tile Association, Inc., are made of structural clay tile and reinforced concrete joists, precast in sections which can be erected without forms. They were used in the St. Albans house pictured here, and demonstrated that fireproof and insulated floors can be speedily built at low initial cost. There is no possible depreciation.

The engineering design formula is the same as used for design of the well-known combination tile and concrete rib flat floor and roof slabs which have been used for years in many of the finest modern buildings.

No forming is necessary for JOISTILE Slab construction.

The precast tile and concrete sections provide a solid

Precast Tilecrete section and method of handling it slab over which the concrete topping is poured. When the slab is completed, it has the same strength as any other system having the same amount of reinforcing steel and resisting concrete.

JOISTILE floor and roof slabs are 100 per cent fireproof—solid—substantial—and more economical than any other fireproof slab system known. They save time in construction, as the precast sections can be made while the foundation is being built and can be put in place as soon as the supporting walls are ready. The precast sections form a solid burned-clay tile ceiling for plaster. If plaster is not desired, smooth-faced tile can be used—which provides a pleasing, finished ceiling for basement, garage, playroom, etc.

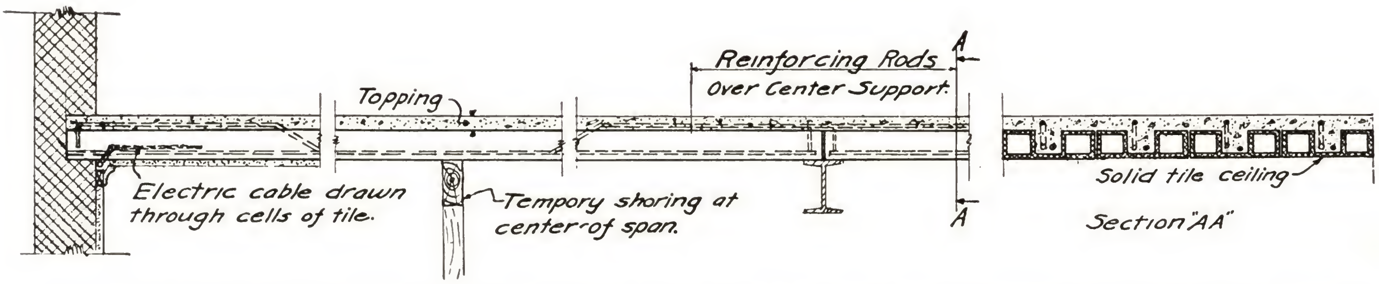
Electric cables can be drawn to outlets through hollow cells of the tile which also provide space for pipes, etc.

THE COST OF THE JOISTILE SLAB. The cost of this floor slab would be 30 to 35 cents per square foot if union wages are paid. This price includes the complete slab with cement finish topping for spans up to 16 feet.

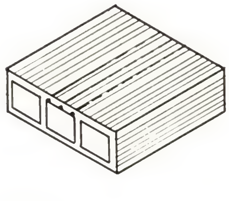
HOW TILECRETE SLABS ARE MADE

The tile are received from the factory with the top center shell heavily scored on the inside, as shown in Cut No. 1, and are easily broken out on the job by tapping with a hammer. Cut No. 2 shows the tile with the top center shell removed, after which they are placed end to end as shown in Cut No. 3. The necessary reinforcing rods are placed in the open channel which is then filled with concrete—made with quick-setting cement—and allowed to cure for about three days, after which the precast sections can be handled safely and placed side by side in position on the walls or the supporting beams in the building, ready for the concrete topping. No forming is required except a temporary shore at the centers of the spans, which can be removed after the concrete topping has hardened.

A crew of five men can put the precast sections in place and pour the topping for an ordinary six- or seven-room house in less than one day. If the topping is made with quick-setting cement, it will be sufficiently hardened next morning to permit the masons to start work on the upper walls.

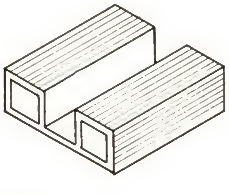

Reinforcing Rods
Over Center Support
A
Topping
Electric cable drawn through cells of tile.
Tempory shoring at center of span.
A
Solid tile ceiling
Section "AA"

TILECRETE FLOOR SLAB ASSEMBLED COMPLETE. *The cells of the tile provide excellent conduits for electric cables, piping, etc. The temporary shoring at center of span can be removed as soon as the concrete topping is sufficiently hardened. This floor is designed with the same engineering formulae that are used for all other types of reinforced concrete rib slab construction*



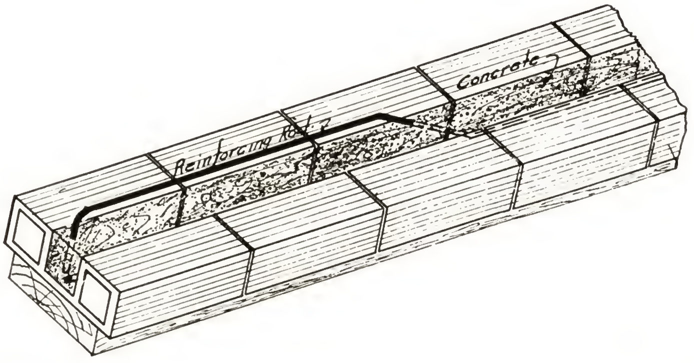
No. 1

Tile as received from the factory with top center shell heavily scored inside so that it can be broken out easily by tapping with a hammer



No. 2

Tile with top center shell removed



No. 3

After top center shell is removed, the tile are placed end to end on a plank. Reinforcing rods are put in place in the open channel thus formed, which is then filled with concrete made with quick-setting cement. The sections can be stacked one above the other while curing. The sections can be handled safely at the age of three or four days and put in position on supporting walls or beams in the building, after which the concrete topping is poured

THE FIRESAFE CONCRETE MASONRY HOUSE

By WILLIAM F. LOCKHARDT

Portland Cement Association.

● FOR YEARS concrete has been regarded by many homeseekers as an ideal house-construction material. Its many obvious advantages—beauty, economy, durability, adaptability, structural strength, fire resistance, immunity to insect attack (termites, etc.)—have won it a rapidly increasing number of staunch supporters. The far-seeing home builder today rightfully insists on a permanently attractive, low-maintenance construction without excessive initial cost; he is impressed by the fact that in most localities a concrete wall of the type described herein is lower in first cost than any other type of all-masonry construction.

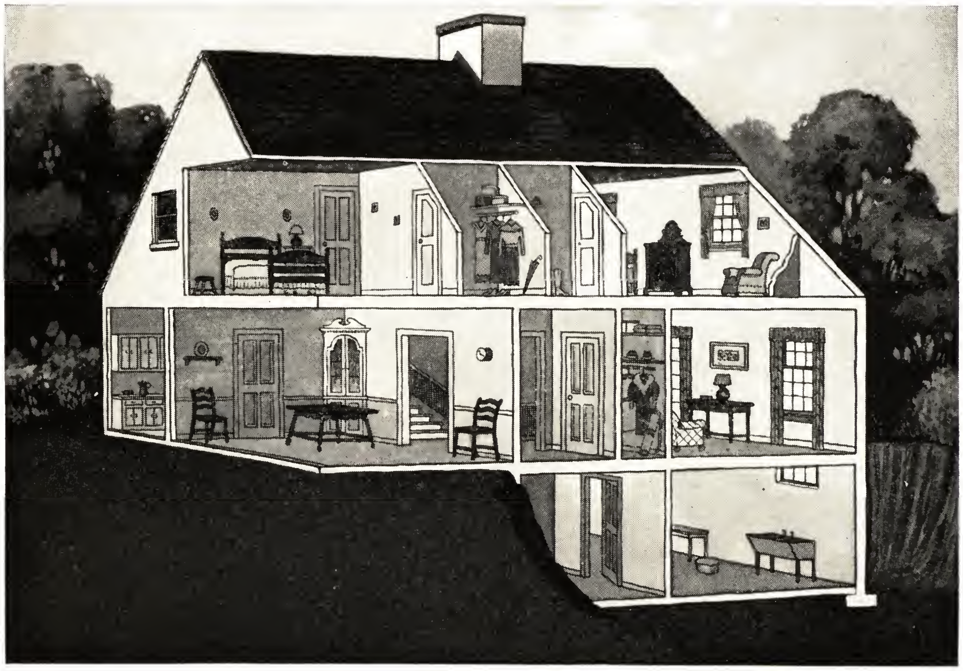
In the majority of concrete houses being built today, the concrete is used in the form of factory-made hollow building blocks or tiles. Shaped by massive high-production machines, these building units are made to exceed the strict requirements for strength and absorption set by the U. S. Government—who use these units in large volume for post offices, courthouses, official buildings, as well as for its housing projects which total thousands of homes.

These concrete masonry units have many advantages. They are available locally in almost every community of any size in the country; there are no long expensive hauls involved and no shipping delays. Many of the types of block in common use have a high degree of insulating value in themselves, for which the home builder pays nothing extra. No specialists are required to place them; they are laid by the bricklayer, who is available everywhere. Since they are of such size that they can be used to back up a brick veneered wall without cutting or fitting, they make possible an all-masonry, brick exterior house at little more than the cost of less substantial construction. It is worth noting, however, that because most lightweight concrete blocks have an agreeable, rough surface texture, leading architects today are saving their clients money by using the blocks themselves for architectural effect, without covering of any kind. These, the last word in up-to-the-minute style in wall beauty, are called *ashlar,* the term "ashlar" being used by masons to designate walls built of large pieces of masonry, such as were used in other days for the charming and picturesque Old-World manor houses so universally admired and copied.

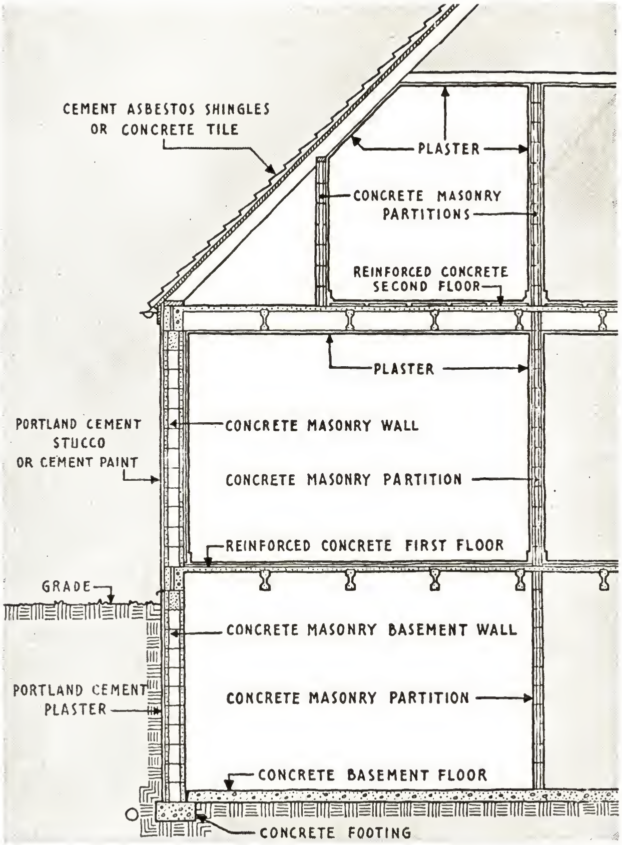
By combining such walls with the newly developed concrete joist floors described herein, firesafe construction, with its many dollars-and-cents advantages, is for the first time made feasible for homes of moderate cost. Besides the priceless boon of freedom from worry over the safety of loved ones, concrete floors make for easy housekeeping every day and pleasanter living always.

The story of the FIRESAFE CONCRETE MASONRY HOUSE AND HOW IT'S BUILT, is told graphically in the pictures which illustrate this article. Starting with the cutaway view of a small home which combines traditional architecture with twentieth-century building methods, the entire construction of the house can be traced, step by step, through the various pictures in sequence.

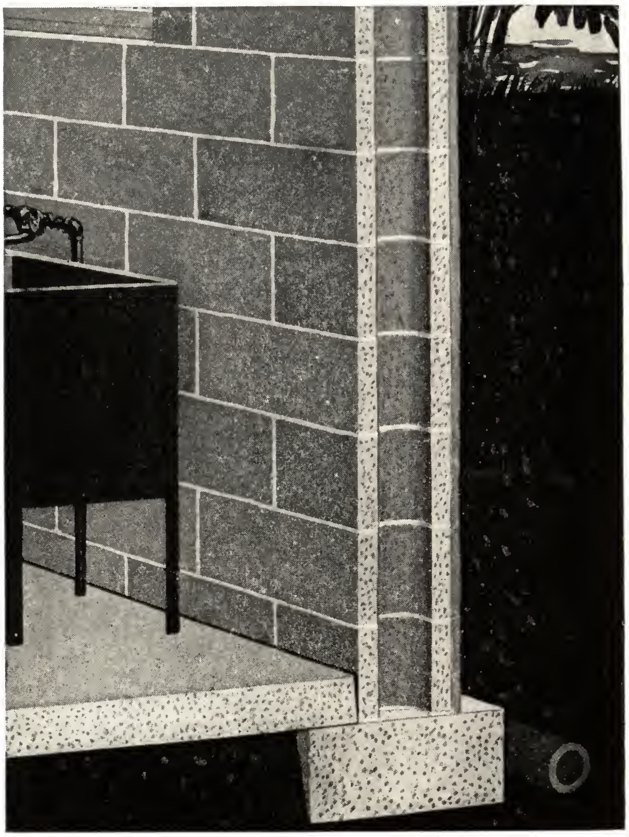
In the second illustration a slice has been taken right through the house shown in the cutaway picture. This shows clearly the relation of the various parts of the construction; the construction of the basement floor, the foundation walls and basement partitions, the reinforced concrete first floor carried on precast concrete "I"-beams, etc. One departure from ordinary framing practice will be noted, namely, that partitions are not necessarily carried directly over supporting members or beams. This is because the strength of the concrete floor construction can be adjusted, if desired, so that partitions may be placed most advantageously from the standpoint of room planning, without regard to the construction beneath.



Cutaway perspective of house


CEMENT ASBESTOS SHINGLES OR CONCRETE TILE
PLASTER
CONCRETE MASONRY PARTITIONS
REINFORCED CONCRETE SECOND FLOOR
PLASTER
PORTLAND CEMENT STUCCO OR CEMENT PAINT
CONCRETE MASONRY WALL
CONCRETE MASONRY PARTITION
REINFORCED CONCRETE FIRST FLOOR
GRADE
CONCRETE MASONRY BASEMENT WALL
PORTLAND CEMENT PLASTER
CONCRETE MASONRY PARTITION
CONCRETE BASEMENT FLOOR
CONCRETE FOOTING

CROSS SECTION OF FIRESAFE CONCRETE MASONRY HOUSE. *This view, taken directly across the house, shows how concrete walls, floors and partitions make for firesafety, as well as for permanence and low upkeep, at minimum first cost.*



Below-Ground Construction. The waterproofing coat of cement plaster and the drain tile outside the footing show plainly.

THE FOOTING

Good construction starts with the footings which carry the house. If the footings are too small, the load on the soil may be greater than it will carry without settlement, and cracked walls will result. This may also occur where the footings are not properly proportioned for the different loads they have to carry.*

For the home we are considering, the concrete footings are made 9 inches deep by 18 inches wide to avoid settlement.

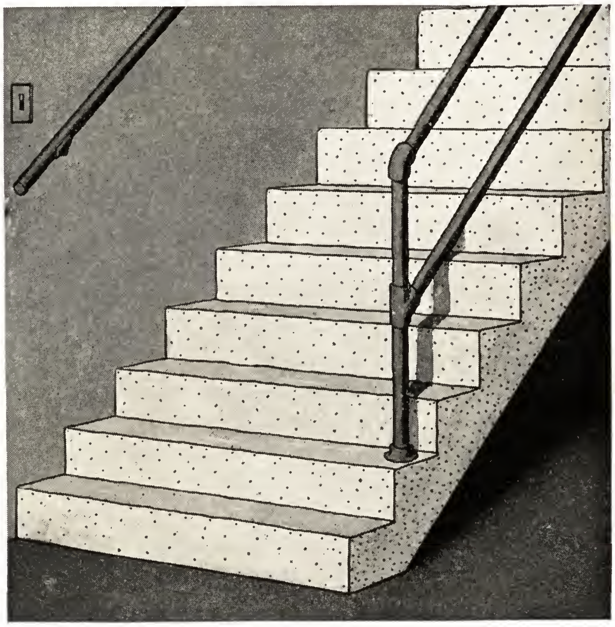
THE BASEMENT WALL

For a one or one-and-a-half story house, the foundation wall is made 8 inches thick; for a two-story house, 12 inches thick. If concrete masonry units are used, it is the usual practice to plaster the outside face of the wall with Portland cement mortar. This insures complete watertightness, which always is desirable, especially where basements are used for recreation.

THE BASEMENT FLOOR

The basement floor is concrete at least 4 inches thick. To give the floor a smooth finish, a ½-inch topping of Portland cement mortar is applied while the slab is still plastic. Then the topping, which may be colored, is troweled lightly.

A space, left between the slab and basement wall, is filled with waterproofing material (asphalt or tar) to provide a watertight joint.



THE STAIRS

To add fireproofness to the homes, it is important to build stairs with a fire-resistant material. Reinforced concrete is well suited for this purpose.

Basement stairs are illustrated. Stairs from the first to the second floor will be similar. However, for the home being built, figuratively, in this article, it will be desirable to color the treads and risers.

If desired, concrete stairs may be covered with carpet or colored tile treads, or encased in wood.

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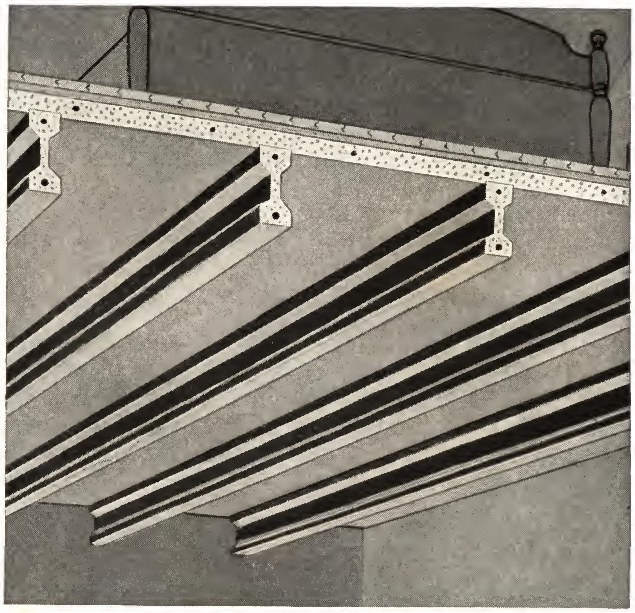
*The proper design of footings for all types of construction is explained in the booklet *Foundation Walls and Basements of Concrete* which may be obtained without charge from the Portland Cement Association.



Low-Cost, Fireside Floors. Factory-cast concrete I-beams bring durable floors within modest budgets.

LOW-COST, FIRESAFE FLOORS

In the firesafe home, precast concrete joist floors are used. These floors will not shrink open at the baseboards, will remain firm under heavy use, will never sag or rot, and cannot be attacked by termites. Many homeowners like the paneled beam ceiling shown here, but a conventional flat plaster ceiling is easily obtained. Metal channels and small mesh metal reinforcement are attached to tie wires embedded in the concrete. Plaster is applied directly to the metal reinforcement.

Artistic Treatment of Beamed Ceiling. Attractive designs in color are stenciled on these beams to enrich the ceiling of this living room.

DECORATIVE CONCRETE JOIST CEILINGS

It is more economical, of course, to decorate the joists and the slab, as shown in the photograph, than to use plaster.

Many people prefer a painted joist ceiling. It is a simple matter to obtain contrasting color effects between the joists and the slab, and this treatment helps to enliven the scheme of decoration. Any color or combination of colors may be used. Stencil treatments are frequently employed.

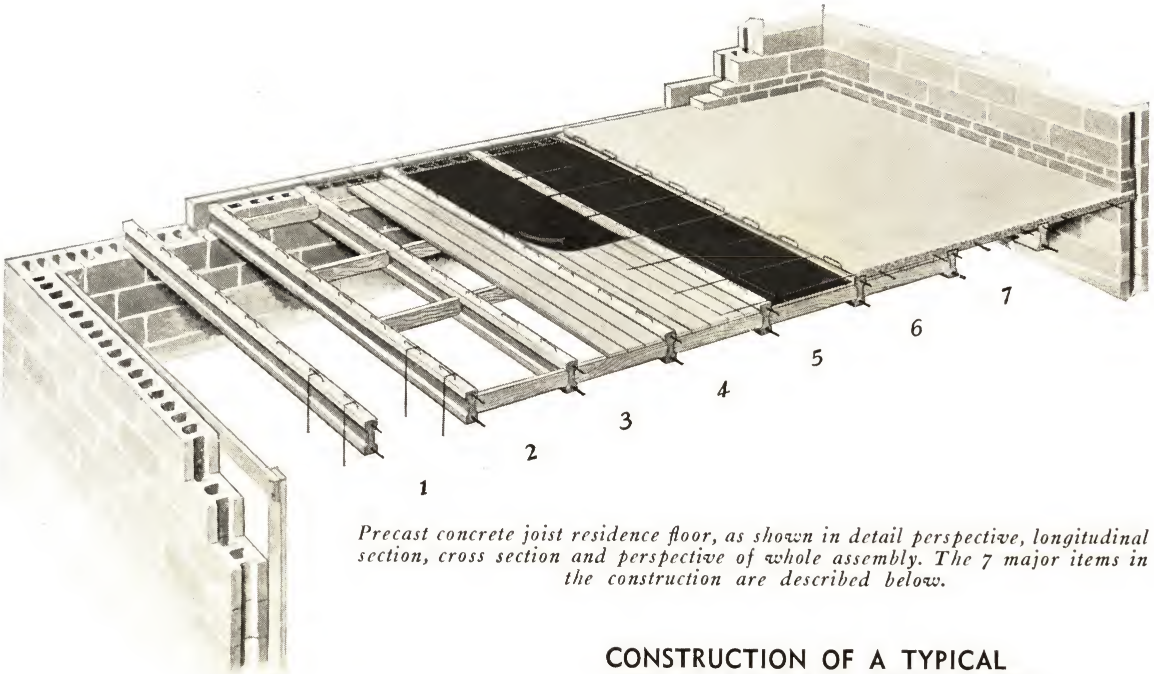
Decorative concrete floors are the coming vogue, home construction authorities say. Women, who have enjoyed the easy housekeeping that such floors provide, are enthusiastic about them.

ARTISTIC CONCRETE FLOORS FOR EASY HOMEKEEPING

Because of its attractive and distinctive appearance, the colored concrete floor finish is coming into popular favor. It is easy and pleasant to live on, provides long wear, and is readily kept bright and new.

The colored topping is made from a mixture of Portland cement, aggregates (sand, gravel or broken stone), water and mineral color pigments. To get the highest quality of finish, the contractor uses only mineral oxide.

Colored concrete finish may be marked off into patterns, as shown in the photograph above, and the surface brought to a high gloss by waxing and polishing. Another method of coloring is to apply chemical stains.



Precast concrete joist residence floor, as shown in detail perspective, longitudinal section, cross section and perspective of whole assembly. The 7 major items in the construction are described below.

WOOD FLOORS OVER FIRESAFE CONCRETE

Many owners combine the strength and permanence of concrete with the beauty of fine woods. Hardwood flooring commonly is nailed to wood strips attached to the concrete structural floor. If desired by the architect, a loose, porous fill of screened dry cinders is placed between the nailing strips.

When a finish of wood flooring is chosen, the concrete structural floor underneath stays on the job night and day, preventing the spread of fires originating in the basement.

COMPOSITION FLOOR FINISHES ON CONCRETE

Cork tile, linoleum, and rubber flooring are popular finishes for concrete floors. These are cemented directly to the concrete surface, after it is thoroughly dry, or to a felt cushion. Either method is satisfactory.

CONSTRUCTION OF A TYPICAL PRECAST CONCRETE JOIST FLOOR

(1) Set precast concrete joists.

(2) Set bridging between joists at foundation walls. Insert spreaders. Place wire hangers for plastered ceiling if specified.

(3) Lay sheathing on spreaders. Box openings for service connections.

(4) Lay waterproof building paper, if smooth ceiling is required. For wood floor finish, place sleepers at right angles to joists (or floor may be cemented directly to slab).

(5) Place slab reinforcement ¼ in. round bars, 10 in. on center, at right angles to joists; 18 in. on center, parallel to joists. (Large-mesh metal reinforcement of equivalent effective area may be substituted.)

(6) Place concrete slab 2 in. thick, when joist spacing is less than 27 in.; 2½ in., when spacing is 27 to 30 in.

(7) Remove forms (spreaders and sheathing) after concrete has been moist-cured 5 to 7 days.

Wood Floors Over Firesafe Concrete

Composition Floor Finishes on Concrete

An Architect's Home of Beautiful Concrete Ashlar

AN ARCHITECT'S HOME OF BEAUTIFUL CONCRETE ASHLAR

The attractive entrance porch shown in this article is part of the residence of Clarence E. Day, architect. The walls of this house are random concrete ashlar, painted white. The paint does not obscure the mortar joints, so the attractive masonry effect is retained.

The exact cost of such walls as these will vary to some extent with the type of ashlar pattern selected. The simpler designs, consisting largely or wholly of full-size blocks, will be less costly. The omission of the stucco covering will reduce the wall cost from 15 cents to 25 cents per square foot; the cost of a good two-coat job of waterproof Portland cement paint will be approximately 5 cents per square foot.

Another type of ashlar wall that is very popular with architects and home-builders employs colored block. High-grade mineral pigments are added to the concrete mix before the blocks are molded; in this way almost any desired color, or range of color, can be obtained. Walls in which several related colors, such as buffs, yellows, and cream tones are used are considered more attractive than those in which only one color is employed. Sometimes, however, variety is obtained by using several shades of one color, some lighter, some darker.

Walls of colored units, which are not covered with a waterproof cement paint, are preferably finished with two coats of clear (sometimes called "colorless") waterproofing to seal the mortar joints.

BUILDING THE CONCRETE MASONRY WALL

The term concrete masonry is applied to block, brick or tile building units molded from concrete and laid by masons in a wall. The concrete is made by mixing Portland cement with water and materials such as sand, pebbles, crushed stone, cinders, slag, burned shale or clay, etc.

After mixing, the concrete is forced into steel molds by heavy power-operated rammers or tamps, which compress and densify the concrete. The blocks are then ejected from the molds in such a way that the faces of the block are troweled or smoothed, to further add to their weather resistance. The "green" blocks then move to the "curing" chambers, where they are subjected to controlled heat in a moisture-saturated atmosphere for 24 hours or longer, if need be, to develop the full strength-giving properties of the cement used in the concrete.

Such block not only represent the last word in the scientific manufacture of high-grade building materials, but as a result of the research which has been done in the last few years, these units have only about one-half the absorption of other commonly used masonry materials, thus assuring dry, healthful construction at low cost.

Concrete masonry walls are built quickly by competent workmen and, therefore, are economical. The strength of such walls far exceeds the loads they carry in any dwelling house.

As a result, this type of construction has been approved by building codes generally, and by such authorities as the various construction and lending agencies of the United States Government, and leading architectural, engineering, and construction firms the country over.

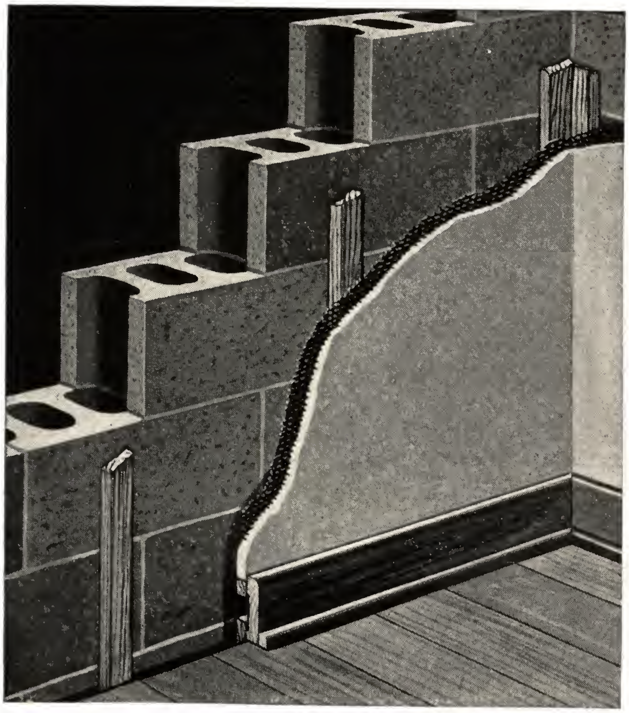
In the photograph below, craftsmen are shown at work laying concrete masonry units into a wall, using a Portland cement-lime mortar consisting of 1 part Portland cement, 1 part lime, and 6 parts mortar sand.

Building the Concrete Masonry Wall

INSULATION AND PLASTER

Here's why the concrete masonry house is always dry and comfortable. On the inside, the concrete masonry walls are finished with plaster applied on metal reinforcement which is furred out from the wall with wood strips or self-furring nails. This forms a 1-inch insulating airspace between masonry and plaster. Nails may be driven into some types of concrete masonry.

Concrete furring tile or rigid insulating board may be substituted for the metal reinforcement as a base for plaster or may be used in place of plaster as a wall finish.



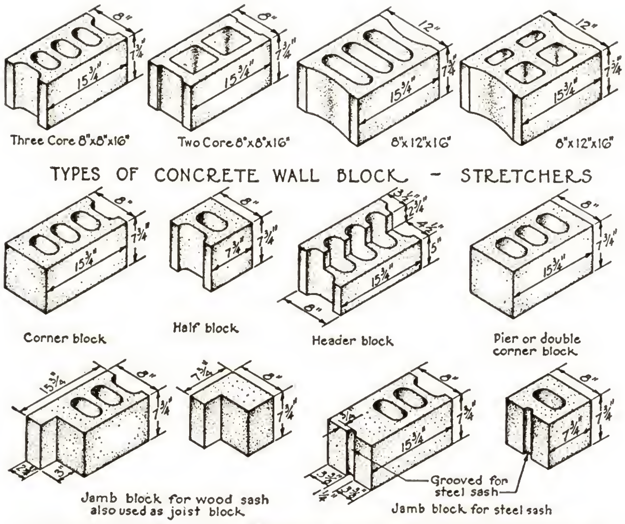
Insulation and Plaster. In addition to the insulation afforded by some types of block, heat losses are checked by the airspace formed between masonry and plaster by the 1" wooden strips shown on the inside of the wall.

PERFECT STUCCO BASE

Concrete masonry makes an ideal base for Portland cement stucco, which is a popular finish because of its colorful beauty and durability. A workman is shown applying Portland cement stucco to a concrete masonry wall.

For stucco work, the mortar is made with 1 sack of Portland cement, 3 cubic feet of sand, and not more than 15 pounds of hydrated lime.

The stucco is applied in three coats. If desired, the final coat may be tinted by adding mineral color pigments to the mixture or by using prepared Portland cement stucco.

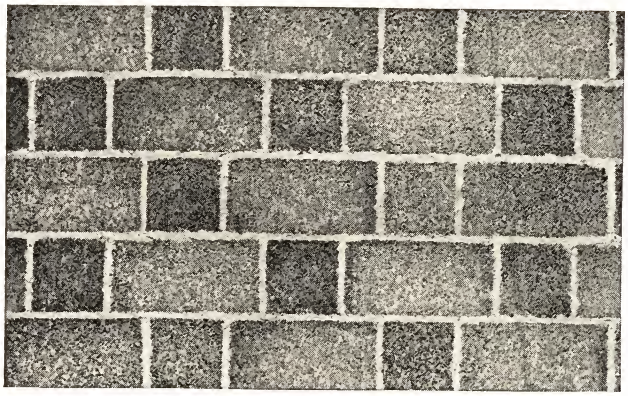

8"
7¾"
15¾"
Three Core 8"x8"x16"
Two Core 8"x8"x16"
12"
8"x12"x16"
8"x12"x16"
TYPES OF CONCRETE WALL BLOCK - STRETCHERS
Corner block
Half block
Header block
Pier or double corner block
3½"
2¾"
4½"
5"
2"
3"
Jamb block for wood sash also used as joist block
Grooved for steel sash
Jamb block for steel sash

STANDARD SPECIALS FOR 8" BLOCK, ALSO MADE IN THE TWO CORE TYPE
SIMILAR SPECIALS ARE REGULARLY FURNISHED FOR 12" BLOCK

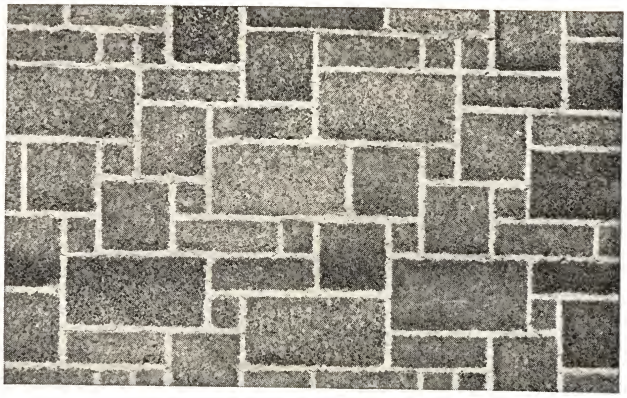
Inasmuch as it is extremely difficult to mix in pigments at the job with sufficient thoroughness to avoid streaking and spotting, it is strongly recommended that a prepared Portland cement finish coat be bought from some reputable manufacturer, where color is desired.

A wide variety of textural finishes can be obtained by a skillful plasterer, simply by varying the manner in which he holds his trowel. A number of the more popular types of stucco finishes, together with step-by-step illustrations of the manner in which the plasterer manipulates his trowel to secure the desired effects, are contained in the book "Portland Cement Stucco" which may be obtained without charge from the Portland Cement Association by those who are planning to stucco their homes.

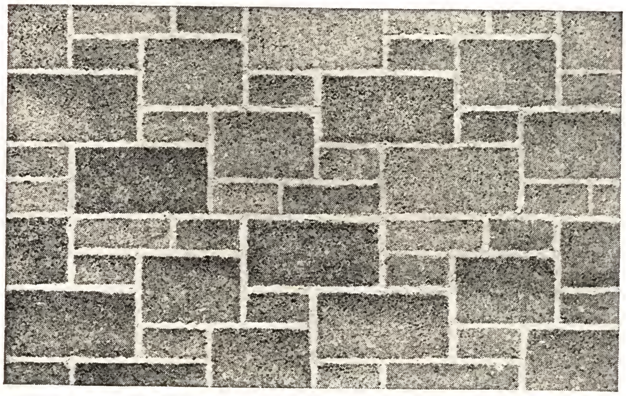
Perfect Stucco Base. The rigid unyielding concrete masonry wall assures stucco satisfaction. A second coat will bring the wall to a true plane; the thin third coat supplies color and texture for architectural effect.



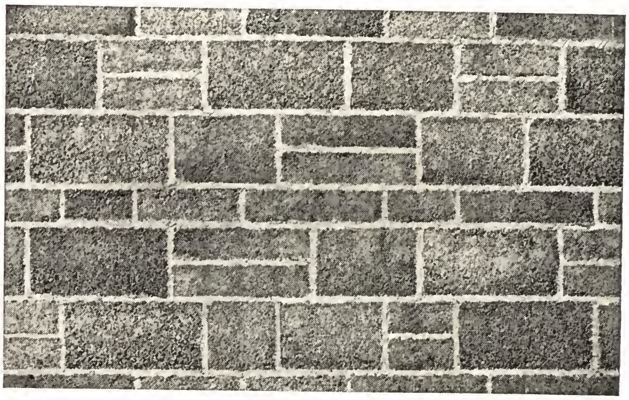
Coursed ashlar pattern using two sizes of concrete masonry units—8 by 16 and 8 by 8. The horizontal joints are continuous on 8-inch centers, the alternating pattern repeating in each course.



This popular random ashlar effect is achieved by the use of only four nominal sizes of concrete masonry units—8 by 16, 8 by 8, 4 by 12 and 4 by 4 inches. Pattern repeats in each square yard of wall area.



A pattern which combines coursed and random effects has continuous horizontal joints every two feet. Face sizes of masonry units are 8 by 16, 8 by 12, 4 by 12 and 4 by 8 inches. Pattern repeats horizontally every 3 feet.



Another example of coursed ashlar. Here there is one 4-inch course to each pair of 8-inch courses. The pattern is formed by units with nominal face sizes of 8 by 16, 8 by 12, 8 by 8, 4 by 16, 4 by 12 and 4 by 8 inches.

CONCRETE ASHLAR WALLS

A modern development in the masonry field is ashlar construction using concrete masonry units, either in standard sizes or in a combination of standard and fractional sizes.

Ashlar construction is known as coursed ashlar when the units are arranged according to height to form regular courses in the face of the wall. It is called random ashlar when several sizes of units are laid up at random. It is called patterned random when the units are laid apparently at random but actually are laid to a definite pattern which is repeated again and again in the face of the wall.

ARCHITECTURAL TREATMENT

Concrete ashlar offers many possibilities for architectural treatment. In fact, architects can achieve practically any effect desired, since concrete ashlar permits the use of color and the development of textures in addition to a wide choice of patterns, limited only by the ingenuity of the designer.

Color can be introduced by using selected aggregates in the facing of the units when they are manufactured, or by using mineral pigments in the concrete from which the units are molded. Also, the units can be stained or colored with Portland cement paint as they are taken from the machine, or the finished walls can be suitably colored with Portland cement paint or with stains.

Practically any texture desired from smooth to a rough, open texture can be produced by the proper selection and grading of aggregates in designing the concrete mixture, or by brushing, scoring or otherwise texturing the faces of the units while they are in a plastic condition.

PAINTING CONCRETE ASHLAR

For both interior and exterior walls a very attractive finish is secured by means of Portland cement paint which is available in a wide selection of colors. The paint may be used in one color, in two colors, or in several blending colors.

A pleasing two-tone effect is produced by spraying the entire surface with Portland cement paint and then touching the high spots with a paint of a different color, usually of a lighter tint. For interior work, where it is desired to preserve the beauty and the natural acoustical properties of open-textured concrete ashlar, the paint is applied in such a manner that it coats the entire surface without filling the tiny depressions which serve to absorb sound waves. Where a two-color finish is desired, the second coat is brushed on the surface, but not in the depressions which retain the tone of the first coat. The general color of the wall is that of the second coat of paint, but the innumerable openings in the surface show through the second coat to provide two-tone effect as well as to emphasize the texture.

HEAT TRANSMISSION OF CONCRETE MASONRY WALLS

The question of heat transmission of walls used in office buildings and residences is assuming increasing importance as the use of higher-priced fuels and the installation of air-conditioning equipment increase.

FROM WHAT STANDPOINT IS WALL INSULATION IMPORTANT?

A certain amount of wall insulation is important, not only from the standpoint of reducing fuel bills in winter and providing cooler rooms in summer, but also from the standpoint of preventing condensation or the appearance of moisture during cold weather on the interior walls in buildings using humidifying equipment.

The heat-insulation value of various types of concrete masonry walls is shown in the table below. The values given are based on data obtained in a research program sponsored by the American Society of Heating and Ventilating Engineers in co-operation with the Portland Cement Association and the University of Minnesota. The report was published in the January 1936 issue of *Heating, Piping and Air Conditioning* under the title, "Thermal Properties of Concrete Construction," by F. B. Rowley, A. B. Algren and Clifford Carlson of the Engineering Experimental Station staff of the University of Minnesota.

HOW DOES THE HEAT LOSS IN CONCRETE MASONRY WALLS COMPARE WITH THAT OF WALLS CONSTRUCTED OF OTHER MATERIALS?

For comparative purposes in using this table, the heat-loss coefficients of other types of construction have been taken from the 1936 *Guide* of the American Society of Heating and Ventilating Engineers. These engineers measure heat loss in terms of British thermal units (Btu.)—units used to measure heat in much the same manner that we use pounds to measure weight. Standard wood-frame construction with ¾-inch plaster on metal lath has a heat loss of .26 Btu. per sq. ft. per hr. This figure, .26 Btu. loss, is considered by heating and ventilating engineers not excessive as far as efficiency is concerned. In fact, it is quite generally accepted as the basing point on which efficiency or inefficiency of heat losses may be measured.

Similar wood-frame construction with 4-inch brick veneer in place of siding and ¾-inch plaster on metal lath interior has a heat loss of .28 Btu. per hr. An 8-inch solid brick wall with furred metal lath and ¾-inch plaster has a heat loss of .28 Btu. per hr.

The table indicates the results secured in the co-operative tests at the University of Minnesota for various types of concrete masonry units. A study of this table and the comparative values given will bring out an important point not generally recognized: that is, the very small difference in the heat loss between frame and concrete masonry walls, provided they have the same interior treatment.

WHAT IS A SIMPLE METHOD OF INCREASING THE INSULATING VALUE OF CONCRETE MASONRY WALLS?

One of the outstanding facts brought out in the investigation conducted at the University of Minnesota was that filling the cores of a standard 3-oval core 8″×8″×16″ unit with regranulated cork, Rock Wool, or similar granular or loose fill material with equivalent insulation values would reduce the heat losses through the plain concrete masonry wall substantially 50 per cent. This method of providing additional insulation in concrete masonry walls will prove economical and effective. The test results show that a cinder or Haydite concrete masonry wall with filled cores and two coats of Portland cement paint on the exterior, without interior plaster, reduces the heat losses to 20 per cent less than standard frame construction. Such insulation usually costs from 4¢ to 6¢ per square foot of wall treated.

HEAT TRANSMISSION OF VARIOUS TYPES OF CONCRETE MASONRY WALLS

Based on data obtained in co-operative research sponsored by the American Society of Heating and Ventilating Engineers in co-operation with the Portland Cement Association and the University of Minnesota. The report was published in the January 1936 issue of *Heating, Piping and Air Conditioning* under the title, "Thermal Properties of Concrete Construction," by F. B. Rowley, A. B. Algren and Clifford Carlson of the Engineering Experiment Station staff.

Coefficient of Transmission U of Concrete Masonry Walls, Wind Velocity 15 Mi. Per Hr.

Basic Wall Construction	*Cores of Units Not Filled*			*Granular or Loose Fill in Cores*		
	Interior Finish ¾″ Plaster on Furred			Interior Finish ¾″ Plaster on Furred		
	Metal Lath	Rigid Insulation		Metal Lath	Rigid Insulation	
		½-in.	1-in.		½-in.	1-in.
8-in. Concrete Masonry Walls.						
Aggregate: Cinder	.27	.20	.16	.17	.15	.11
Haydite	.25	.19	.15	.15	.13	.11
Sand or Limestone	.32	.24	.17	.26	.20	.16
12-in. Concrete Masonry Walls.						
Aggregate: Cinder	.25	.19	.15			
Haydite	.24	.19	.14			
Sand or Limestone	.31	.23	.17			
12-in. Walls (4-in. brick, 8-in. c/m back-up).						
Aggregate: Cinder	.24	.19	.15	.15	.13	.11
Haydite	.23	.18	.14	.14	.12	.10
Sand or Limestone	.28	.21	.16	.20	.16	.13

Weatherproofinq and Damp-proofing with COPPER

● OUR HOMES of today are far different from the rock-hewn shelter of the cave man, the American Indian's tepee, or the igloo of the Eskimo, for continued scientific progress and the indomitable spirit of a forward-looking people have brought us a higher standard of living than exists in any other country of the world. Yet even now all too many of our homes provide little more than an effective shelter, while others saddle their owners with needlessly high maintenance expense, and still others, though well built and well designed, lack much that provides full opportunity for comfortable, enjoyable and healthful living. Not so, however, with "Houses of Health."

The "House of Health", for instance, may be sealed from basement floor to attic roof with watertight Anaconda "Electro-Sheet" Copper—used very much like ordinary building paper.

WHAT IS "ELECTRO-SHEET"?

An inexpensive thin copper sheet recently made available in long, wide sheets weighing as little as one and two ounces per square foot, this product is deposited electrolytically by a special process of the Anaconda Copper Mining Company. Since it is rust-proof, strong and ductile, "Electro-Sheet" provides the builder with an efficient damp-proofing and weatherproofing material for foundations, basements, walls and roofs—a constructive feature long desired but heretofore not practical to accomplish inexpensively.

FOUNDATIONS AND BASEMENTS

Where basements are not adequately damp-proofed, the penetration of moisture through exterior walls and floors is apt to produce an unhealthful and humid atmosphere—an undesirable condition which certainly has no place in the modern home, particularly since the basement is now very much a part of the living quarters.

Anaconda "Electro-Sheet" Copper, correctly applied to the walls and floor of the cellar by means of suitable adhesive, offers a durable and inexpensive method of damp-proofing. Detail is shown in Figure A.

Where complete damp-proofing of the cellar itself is considered unnecessary, a single ply of one-ounce copper is inserted between the two layers of the floor above the

Fig. A

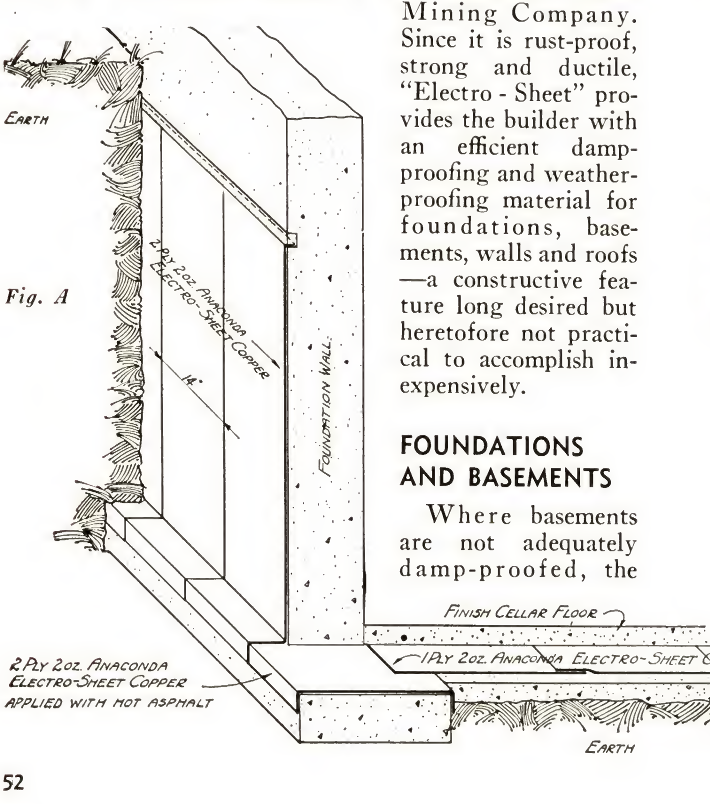

Earth
2 Ply 2oz. Anaconda Electro-Sheet Copper
14"
Foundation Wall
Finish Cellar Floor
1 Ply 2oz. Anaconda Electro-Sheet Copper
2 Ply 2oz. Anaconda Electro-Sheet Copper applied with hot asphalt
Earth

Fig. B

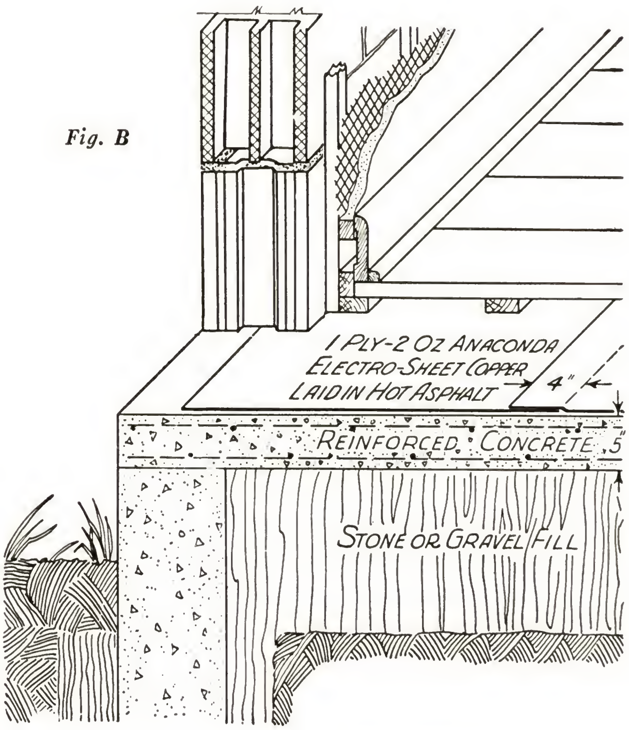
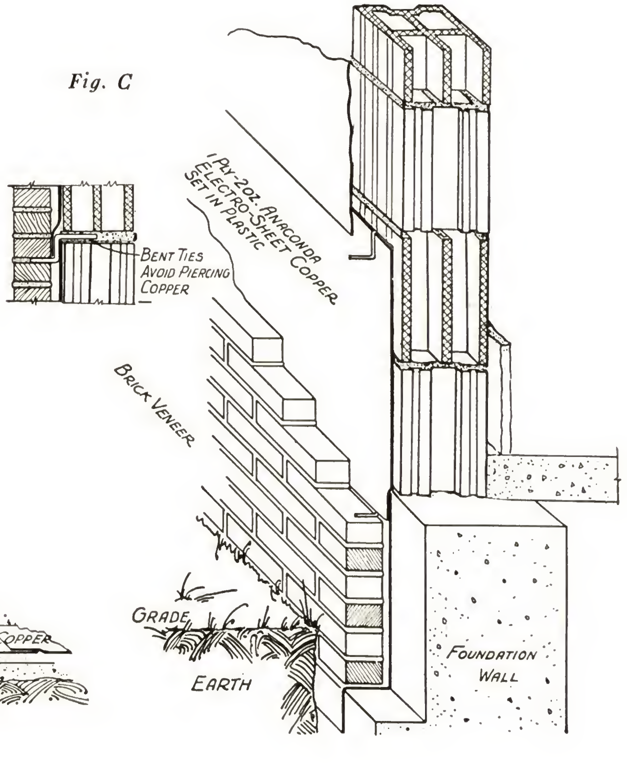

1 Ply-2 Oz Anaconda Electro-Sheet Copper Laid in Hot Asphalt
4"
Reinforced Concrete 5"
Stone or Gravel Fill

Fig. C


1 Ply-2oz. Anaconda Electro-Sheet Copper Set in Plastic
Bent Ties Avoid Piercing Copper
Brick Veneer
Grade
Earth
Foundation Wall

cellar so as to cut off the penetration of moisture and cellar air. See Figure B. If insulating felt or cellular insulation is used, it must be placed above the layer of "Electro-Sheet" to prevent cellar moisture from impairing the efficiency of the insulation.

EXTERIOR WALLS

Brick Veneer. This is a popular type of construction. However, moisture readily penetrates the brickwork and, in time, works completely through the wall unless some protection is provided. Properly applied "Electro-Sheet" not only constitutes a barrier against moisture but also minimizes the infiltration of air. Application is illustrated in Figure C.

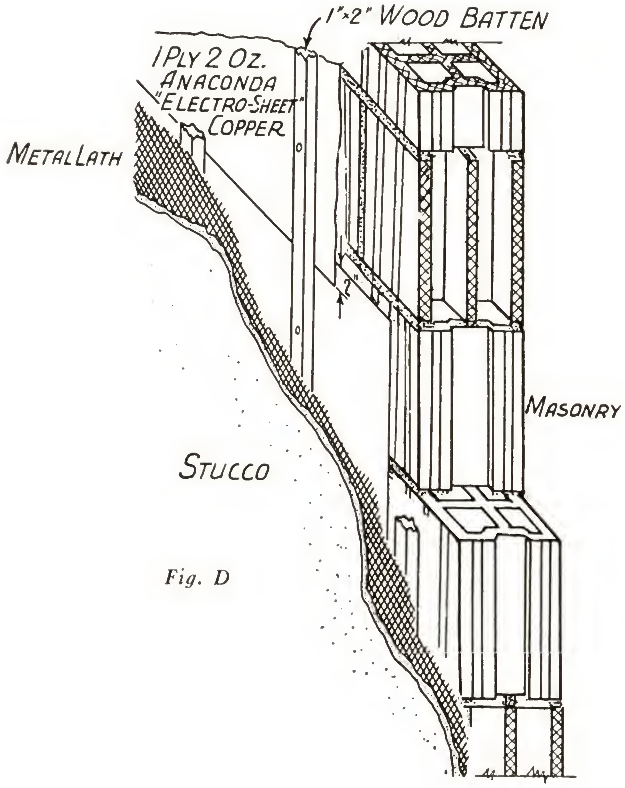


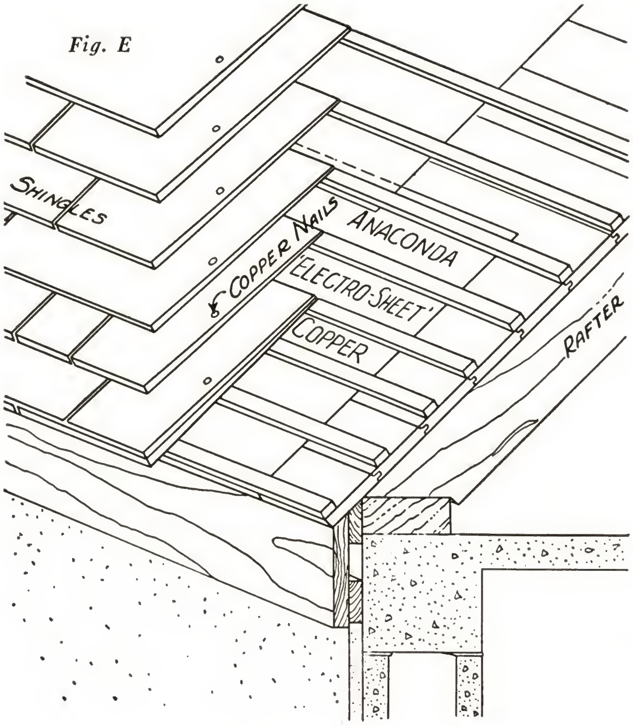
Fig. D

Stucco. Where stucco on metal lath is employed for outside-wall facing, efficient waterproofing is of the utmost importance. In the past, building papers and felts have been generally used to protect the inner wall and frame from any moisture which penetrates the stucco facing. A layer of two-ounce "Electro-Sheet" can be readily applied, as shown in Figure D.

ROOF

Loss of warm air by outward infiltration is most marked at the roof because of the tendency of warm air to rise. A layer of "Electro-Sheet" beneath the surface of the roofing, by providing a practically airtight barrier, effectively minimizes the loss of warm air and the infiltration of cold air. See Figure E.

Fig. E



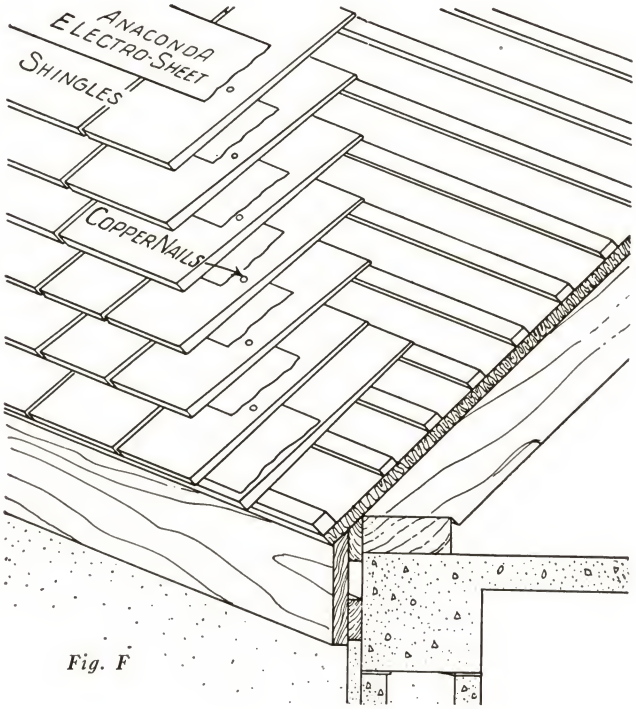
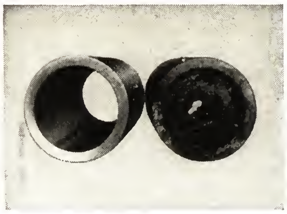


Fig. F

Where the attic is unheated, it may be deemed advisable to nail the "Electro-Sheet" to the sheathing of the attic floor, or, when the floor is unsheathed, the "Electro-Sheet" may be applied over rigid insulating board nailed to the tops of the joists. This procedure confines the warm air to the heated quarters of the building.

The construction shown in Figure F is particularly suited to the reroofing of old houses. Though watertight, the roof would not be entirely airtight unless insulation were used with or in place of the wood sheathing. And it should be borne in mind that, as previously stated, cellular insulating material is most effective only when dry. It can be *kept dry* with "Electro-Sheet" Copper.

The Piping in the "HOUSE OF HEALTH"



Brass pipe (left) and rustable pipe (right) after identical service.

● IN BUILDING or buying a new home you naturally want the most value for every dollar you spend. To make certain of this, care must be exercised to distinguish between what is really important and what only seems important. There are many desirable things—accessories that are useful but not essential—on which action can be postponed.

But there are other things that are vital; matters of sound construction—fundamental things too often overlooked—that mean so much to the enjoyment of your home in after years. Such things as, for example, water pipes, are frequently neglected because they seem but incidentals.

COPPER PIPES TO BE USED

Recent years have witnessed new developments in plumbing practice, directed for the most part toward greater comfort and satisfaction and lowered maintenance costs. One of the most important of these developments, from the standpoint of beneficial results, has been a pronounced increase of the use of rustless brass and copper for hot-water and cold-water piping.

An example of what generally happens when pipes that rust are buried in walls and floors. Isn't it easy to see how costly "cheap" piping can be?

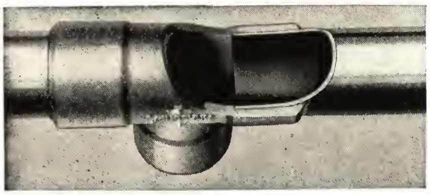
The need for permanent water pipe was not as great a generation ago as it is today. Piping, then, was exposed and easily accessible. Less water was used. Replacements were expected and relatively inexpensive. Today, however, with plumbing concealed behind walls and under floors, the repair and eventual replacement of rusted water lines run into serious expense and annoyance, all of which, as an ever-increasing number of homeowners have come to realize, can be avoided economically and permanently by using durable, rust-proof pipe.

SOLDER-TYPE ASSEMBLIES ARE LOW COST

No one material is ideal for every piping installation. Where low cost is of primary importance, copper tubes and solder-type fittings are finding widespread use. A complete installation costs but a little more than one of short-lived rustable pipe and fittings. This low cost is due to the fact that solder-type joints eliminate threading—making possible lighter tube walls, less weight per foot, and a corresponding reduction in cost. Labor costs are also minimized. However, such important points as thorough cleaning, correct heat, proper fluxing, and the right solder make it imperative to employ an experienced plumbing contractor.

Mechanically, a piping system made up of copper tubes and solder-type fittings provides more than ample strength where conditions of pressure and temperature are normal. In this respect, copper tubes are ideally suited to hot-water and cold-water lines in residential construction.

With rust-proof piping available at such reasonable cost, it is evident that its use affords definite, worthwhile savings



Cut-away section showing completed joint of tube and solder fitting. Note the generous depth of the cup and the accurate fit at the end of the tube. This practically eliminates resistance to the flow of water.

—in addition to the convenience of a full flow of rust-free water, year in and year out.

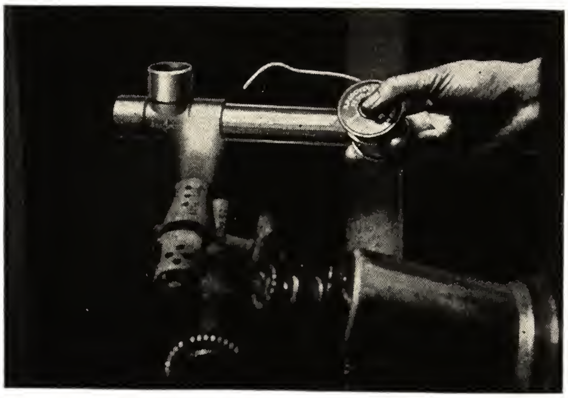
THE THEORY INVOLVED

The natural law of capillary attraction is the principle on which the design of solder-type fittings is based. Metalworkers have employed this principle for years in sweating sections of pipe together. Tests conducted in the laboratories of the American Brass Company have demonstrated that solder can be fed, by means of capillary attraction, vertically upward between two closely fitted tubes to a height many times the distance required to make a solder joint, regardless of the size of the fittings. The perfect bond obtained with this type of joint is revealed by the illustrations at the right.

Anaconda Fittings for assembling copper tubes are available in both wrought copper and cast bronze. The complete line includes a solder-type fitting for every copper tube requirement in plumbing, heating and drainage. Both tubes and fittings are made to the accurate standardized dimensions so essential for sound, leakproof joints. Consult your architect or plumbing contractor. He will tell you which kind of rust-proof pipe you should use. Whether brass pipe or copper tube, be sure the name Anaconda is stamped at frequent intervals in every length.

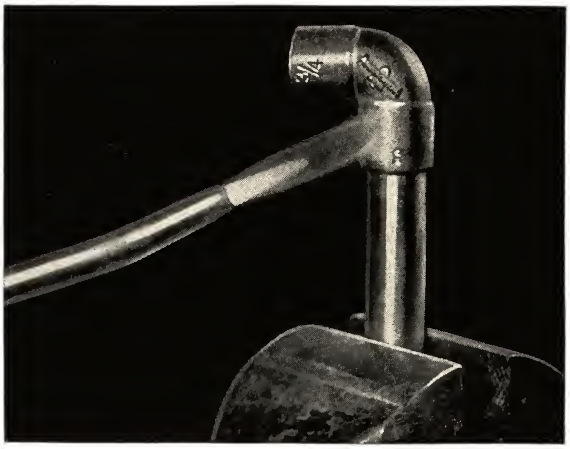
FOR HEATING LINES

An installation of Anaconda tubes and fittings increases the efficiency of hot-water heating systems. Both tubes and fittings have smooth inside surfaces which reduce resistance to the flow of water—especially in forced-circulation systems. Hot water, conveyed through copper tubes, loses only about one half as much heat as is lost when black iron is used. With quicker circulation and reduced heat losses, the maximum amount of heat is delivered to the radiators in the least possible time.

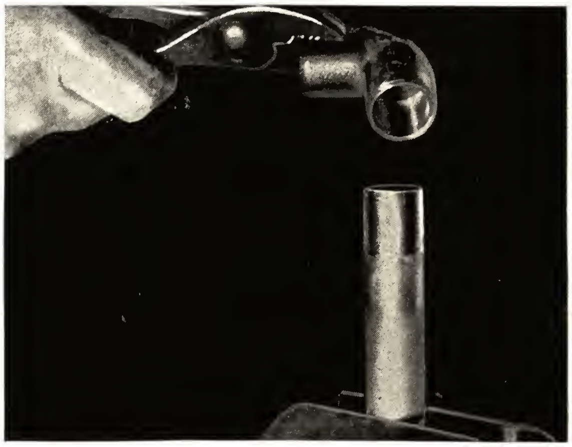


One reason for the remarkably low cost of an Anaconda Copper Tube installation is the manner in which joints are made. Threading is entirely eliminated. After thoroughly cleaning the outside surface of the tube and the inside surface of the fitting, the tube is inserted and the correct amount of heat applied as shown.

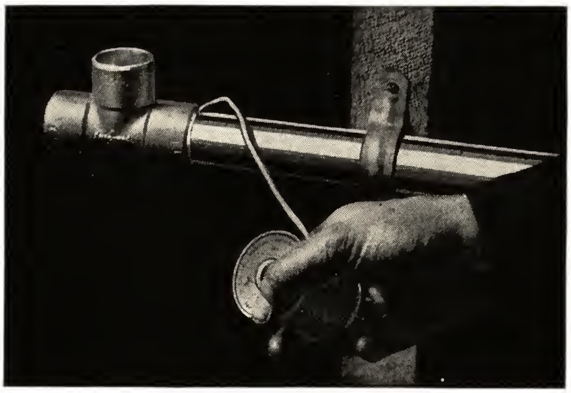
THIS SIMPLE TEST SHOWS THE 100% BOND OBTAINED WITH SOLDER-TYPE FITTINGS. SEE FIGURES BELOW.



To the completed joint, enough heat is applied to melt the solder which bonds the tube and fitting.



How completely the solder covers the tube and fitting is plainly revealed when fitting is removed.



Solder introduced at the edge of the fitting is drawn by capillary attraction throughout the joint. When solder shows around the edge, the joint is completed. There are, of course, several precautionary measures to take—all of which require the skill of an experienced plumber.

TILE for the

"HOUSE OF HEALTH"

STORY OF TILE

● THE HOMEOWNER who uses tile in his residence is applying one of the oldest building materials known to mankind—and one of the most modern in its present development.

The earliest letters, books and business transactions were inscribed on moist and soft tiles, which were later baked or dried to make the inscription permanent. If it were not for the enduring qualities of such materials, man's knowledge of his distant past would be scant indeed.

Tiles as we know them today were originated by the Persians, who burned thin slabs of clay, applied a glaze to the surface, and used them for decorative purposes. The process was adopted by the Egyptians, Chinese, Moors, and later by the Dutch and Italians. Each contributed something of his characteristic art to the improvement of tile-making, and the architectural uses of the material are displayed today in all their original beauty on many well-known buildings in these several countries.

We see, therefore, that the first uses of tile were strictly utilitarian, later decorative, leading to our present use as utilitarian, decorative and sanitary.

ADVANTAGES AND USES

The advantages of tile in the modern home are many. Perhaps the most appealing to the feminine eye are the beautiful colors, available for both floors and walls, and the ease of cleaning tiled areas. The man of the house appreciates the durability and economy of a tile installation, which never needs renewing, and which will outlast the life of most buildings.

There is one advantage of tile which is sometimes overlooked, and that is its verminproof character. Tiles, both floor and wall, are set into a solid cement mortar, and there are no spaces back of the tiles for bugs or other objectionable animal life to exist.

Since tiles are made in relatively small individual units and are available in wide color ranges, almost limitless possibilities of design are opened to the architect or owner. Larger units or skillfully patterned small units may be used to maintain the scale of big areas; smaller units to fit the small room. Bright yellows may be used to light the dark kitchen, bath or nursery, and dull matte glazes will impart a soft sheen to walls where light reflection may not be desired.

The effect of proper color and design is recognized by psychologists as important to the happiness and contentment of the individual. Psychiatrists, indeed, have placed so much faith in this principle that they have called upon tile as a surfacing material in treatment rooms of hospitals for nervous disorders, where interesting applications of designs and colors are used to interest and amuse patients undergoing mental therapy.

WHERE TILE IS USED

The principal areas for which tile is especially suitable are bathrooms, sun porches, kitchens, game rooms, nurseries, indoor and outdoor pools, roof decks and patios. Their advantages apply equally well to walls and floors.

TYPES OF TILE

Tiles divide themselves into two main classes—floor and wall. Wall tiles are generally glazed in various colors, while floor tiles are usually unglazed and derive their color from the clays of which they are composed.

Floor tiles in small units are called "ceramic mosaic" and are shipped from the factory glued to sheets of paper about 2′×1′. The tile setter lays this sheet upon the soft mortar, paper side up, and, when the cement has set, washes the paper off. A number of small tiles may thus be set at one time.

The larger sizes of floor tiles—up to 12″×12″—are generally laid individually.

Wall tiles are made in three principal types—nonvitreous, semivitreous and vitreous, depending upon the degree of absorption of the body. The glaze, in all cases, is tough and impervious. The degree of service determines the type selected—nonvitreous is specified for ordinary interior

use, while vitreous is used for heavy duty and exterior work where freezing may be encountered.

GRADES

Tiles are marketed in two grades, defined by the United States Department of Commerce, Bureau of Standards, specification SPR 61–30. The best quality is "Standard", while those resulting from imperfections in manufacture are called "Seconds."

Standards should always be demanded in residence work, and the owner should insist on a master-grade certificate, specifying the quality used in his particular job.

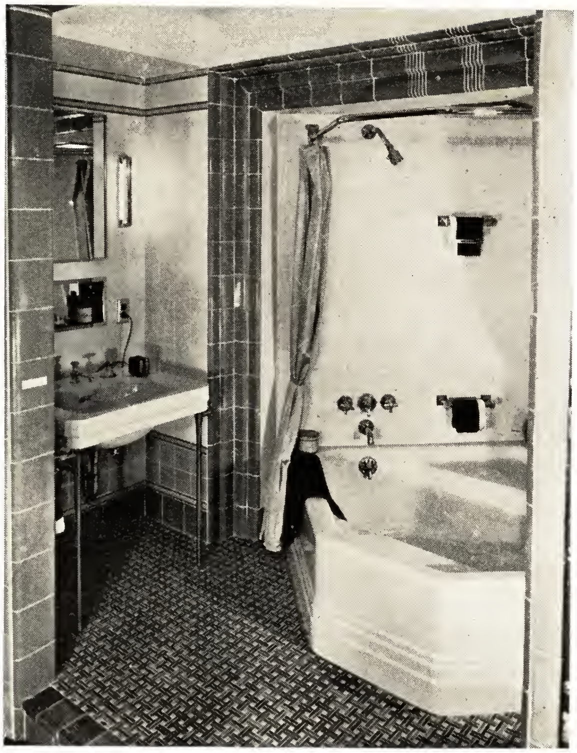
RESEARCH

The development of the precise and uniform tiles of today, with all their range of color and use, was not a haphazard matter. Constant research and experimentation go on in the individual factories and in the Tile Industry Research Bureau maintained at Rutgers University by the Tile Manufacturers' Association, Inc., and sponsored by the Tile and Mantel Contractors' Association.

At this laboratory may be seen machines for testing the ability of tile to withstand all conditions. Huge iceboxes subject tiles to freezing tests; steam chambers known as autoclaves subject samples to tremendous heat and pressure; other devices test resistance to abrasion and impact and determine the non-slip qualities of special floor tiles. Rigorous tests are devised for tiles to be used on exterior work where extreme cold is encountered, and a tile which passed the "weather test" of the Tile Research Bureau will give excellent service under all conditions of exposure.

Here, also, are developed the specifications for tiles used in heavy duty work such as lining the walls of the Holland Tunnel and the Midtown Tunnel between New York and New Jersey.

After a year of research in these laboratories, a new method for setting floor tile has been developed that will have far-reaching effects. Instead of using the standard procedure of setting tile on a thick mortar setting bed composed of cement and sand, this new method calls for only a very thin layer of special plastic cement as a setting bed for the tile. This thin setting bed will be especially effective in remodeling work where it is not convenient to tear up the old floors and use special reinforcement to support the weight of a concrete and mortar setting bed.



Those who are interested in this work, or in any information relating to tiles, may receive full information, without obligation, from the Tile Manufacturers' Association, Inc., 19 West 44th Street, New York City.

COST

Tile is not an expensive material, even when contrasted with acceptable substitutes. A tile bathroom complete with fixtures and backed by a fireproof, leakproof and verminproof cement bed can be had in most places for $90 or $95. If more expensive tile and special shapes and designs are required, the cost would naturally be greater.

TILE IN THE BATHROOM

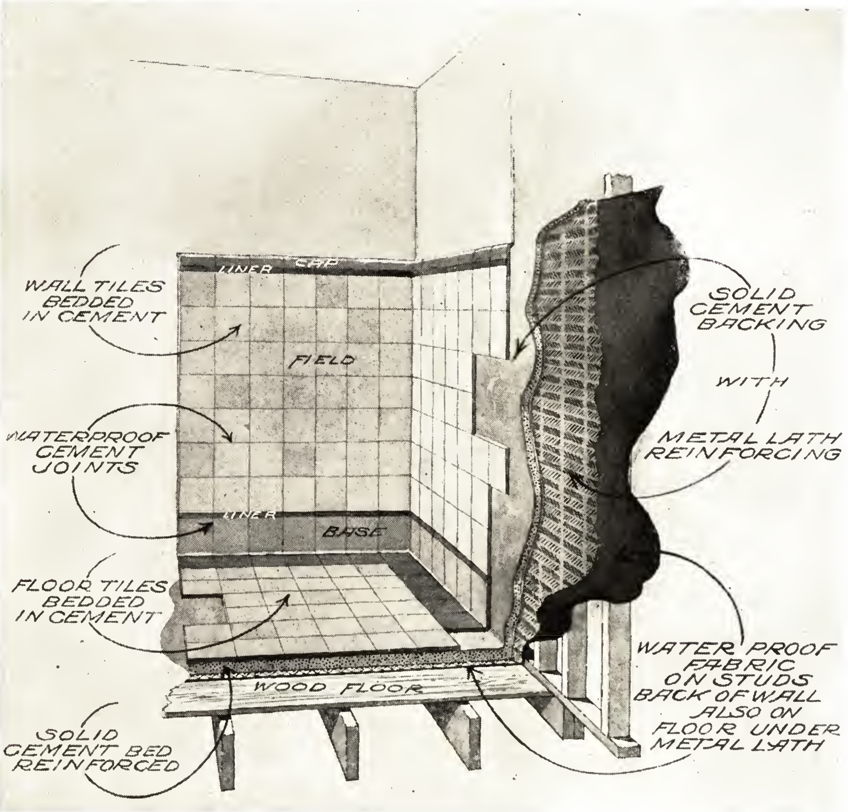
In an average bathroom 6 feet long and 5 feet wide, there are approximately 100 square feet of tile on both wall and floor. At a price of 85 or 90 cents per square foot, the total cost to the homeowner would be about $85 or $90, including fixtures. However, the installation of some other finish material will be a definite item of expense. Therefore, the cost mentioned above will actually be decreased.

TILE IN THE KITCHEN

Tile in the average kitchen can be installed for perhaps less than tile in a bathroom, as a large percentage of the wall area in our modern kitchen is taken up by cabinets, iceboxes, cooking equipment, sinks, at least one window, and two or three doors.

It is well to remember that a cheap material is not cheap over a period of years, because the expense for upkeep and replacement more than offsets the apparent saving in original cost.

HOW TILE IS INSTALLED AND CLEANED


WALL TILES BEDDED IN CEMENT
LINER
CAP
FIELD
SOLID CEMENT BACKING
WITH
METAL LATH REINFORCING
WATERPROOF CEMENT JOINTS
LINER
BASE
FLOOR TILES BEDDED IN CEMENT
WOOD FLOOR
SOLID CEMENT BED REINFORCED
WATER PROOF FABRIC ON STUDS BACK OF WALL ALSO ON FLOOR UNDER METAL LATH

The responsibility for the tilework should be placed in the hands of a competent tile contractor who employs skilled mechanics for setting the tiles and selects the proper cements and other materials necessary to insure a satisfactory installation. Building paper and metal lath are first applied to the frame wall areas to be tiled. A cement and sand mortar known as a "scratch coat" is spread over the lath. After this mortar has hardened, a second coat of cement, lime and sand mortar, known as the "buttering" or "floating" coat, is applied and the tiles set in place. The joints between the individual tile units are then filled with Portland cement, called "grout."

In tiling floors over wood construction it is first necessary to lay down building paper and wire mesh. A cement-and-sand mortar is then spread over the mesh and the tiles set upon it. The floor-tile joints are "grouted" with Portland cement in the same manner as for wall tiles. If the walls and floors to be tiled are on brick or concrete, the building paper, metal lath and shrinkage mesh are eliminated, since the cement mortars can be applied directly upon the masonry.

CLEANING

On wooden floor areas where a thin setting bed is found applicable the surface is first thoroughly cleaned. Then wire mesh or wire lath is nailed to the floor and the area is sprayed or painted with a primer coat. Next a special setting bed mortar is spread over this surface to an approximate 1/8″ thickness. The back of the floor tile is painted or sprayed with the primer coat and set in place. The joints are grouted with a mixture of the same materials used in the setting bed. Solvents such as kerosene and gasoline should be used to remove any stained areas.

Tile is the accepted material for hospitals because of its absolutely sanitary qualities. The tiled home can be kept just as clean as the hospital, and the laborious work formerly required can be eliminated.

Dirt, grease and other foreign matter will not penetrate the body of the tile, and they can be removed very easily. It is not necessary to scrub tiling if proper attention is given to it from the beginning. Ordinarily, nothing more is required than clean warm water and a clean cloth. Where dirt has been ground into the tile floor, the use of an abrasive or gritty cleanser is recommended. Soap solutions should not be used on tile work because soapy film is apt to remain on the tile and form a lodging place for dust.

Glazed wall tiles may be kept as fresh looking as when first installed merely by wiping them with a clean damp cloth. However, grease, dirt and dust may cause a cloudy film or slight discoloration of the surface which can best be removed with a "chemical" cleanser. Do not, under any condition, use a gritty cleaning compound on glazed tiles, as it will in time affect the luster or scratch the highly polished surface. ("Chemical" cleansers such as "Shine-All" or "Wyandotte Detergent" may be obtained at builders' supply stores, or you may use a cleanser of the type of "Oakite", which can be bought from the grocer.)

To clean unglazed tiles, place a quantity of the chemical cleanser in water and mop the tiles well with the solution. Allow the water to remain on the tiles for a few minutes, then rinse with clean water. Dry with a clean cloth. Be sure that the rinsing water is changed frequently.

No other treatment is required unless considerable grease and dirt have been allowed to accumulate. A stiff scrubbing with a fiber brush or steel wool and abrasive cleaner will remove such accumulations.

While it usually is not desirable to wax the kitchen or bathroom floors, it is sometimes possible to secure a pleasing luster by polishing the floors in foyers, sunrooms, and dining rooms. This effect is possible particularly on tiles of red, buff, salmon, chocolate, black and gray colors. "Shine-All" and "Johnson's Liquid Floor Wax" are two materials which may be used for this purpose.

HEALTH CHARTS for the Three Major Heating Systems

● CLINICS are not confined to the medical profession. The health of the individual depends so much on adequate, controlled temperature in providing healthful, comfort-giving heat. To attain this objective the Anthracite Insitute has made exhaustive studies in the field and in research laboratories. Among the findings are the facts that approximately two-thirds of the heating troubles are due to faulty heating plants; in addition, nearly one-fourth of the troubles are due to improper firing of the heating plants. So it will be seen that at least nine out of ten of the heating-plant troubles are due to circumstances not in any way connected with the fuel used.

These findings have been worked up in the form of health charts, or so they might well be called. These charts, which are shown in the following pages, indicate the "sick" and the "well" heating plant, but, naturally, all of the "diseases" could not be shown in the charts. However, the basic common troubles and "cures" are shown. Just as the ailments of men, women and children might be classified, so have the basic three heating methods been separated into steam or vapor, hot water, and warm air.

GENERAL HINTS FOR LOCATING HEATING DIFFICULTIES

It might be assumed that a given heating "disease" might have identical symptoms at all times. This is not the case. For instance, a fire may be sluggish and give insufficient heat although the equipment is normal, except that the chimney size is incorrect or the chimney is unclean, therefore having an effect on the amount of draft provided. This is solely a chimney condition.

If the fire is normal and a steam or hot-water system fails to heat properly, then look to the purity of the water. It may be contaminated with oil or other foreign matter which will have an effect on its steaming or circulation efficiency.

If a warm-air system is operating sluggishly with what appears to be a normally good fire, look to the air pipes or ducts for stoppages which prevent normal circulation of the air.

If a radiator becomes hot all over but fails to heat the room properly, a larger radiator is needed.

If the whole system fails to get its proper share of heat or if certain radiators heat properly and others do not, look to the piping size, whether heat is lost because of uncovered pipes, or whether the piping is improperly proportioned or laid out.

Clinkers are melted ashes—and the melting occurs because of the misapplication of air to the fire either as to where the air enters or as to quantity—and are usually caused by wrong firing methods and incorrect use of the drafts.

Partly burned coal in the ashpit will indicate that the fire is being shaken too violently or that too large a size of coal is being used for the depth of the furnace.

Irregular heating or difficulty in banking the fire may be due to improper location or adjustment of dampers or other controls.

The foregoing points in locating heating troubles are given to assist in further and more effective use of the charts shown in the following pages.

HEATING REQUIREMENTS BY MONTHS

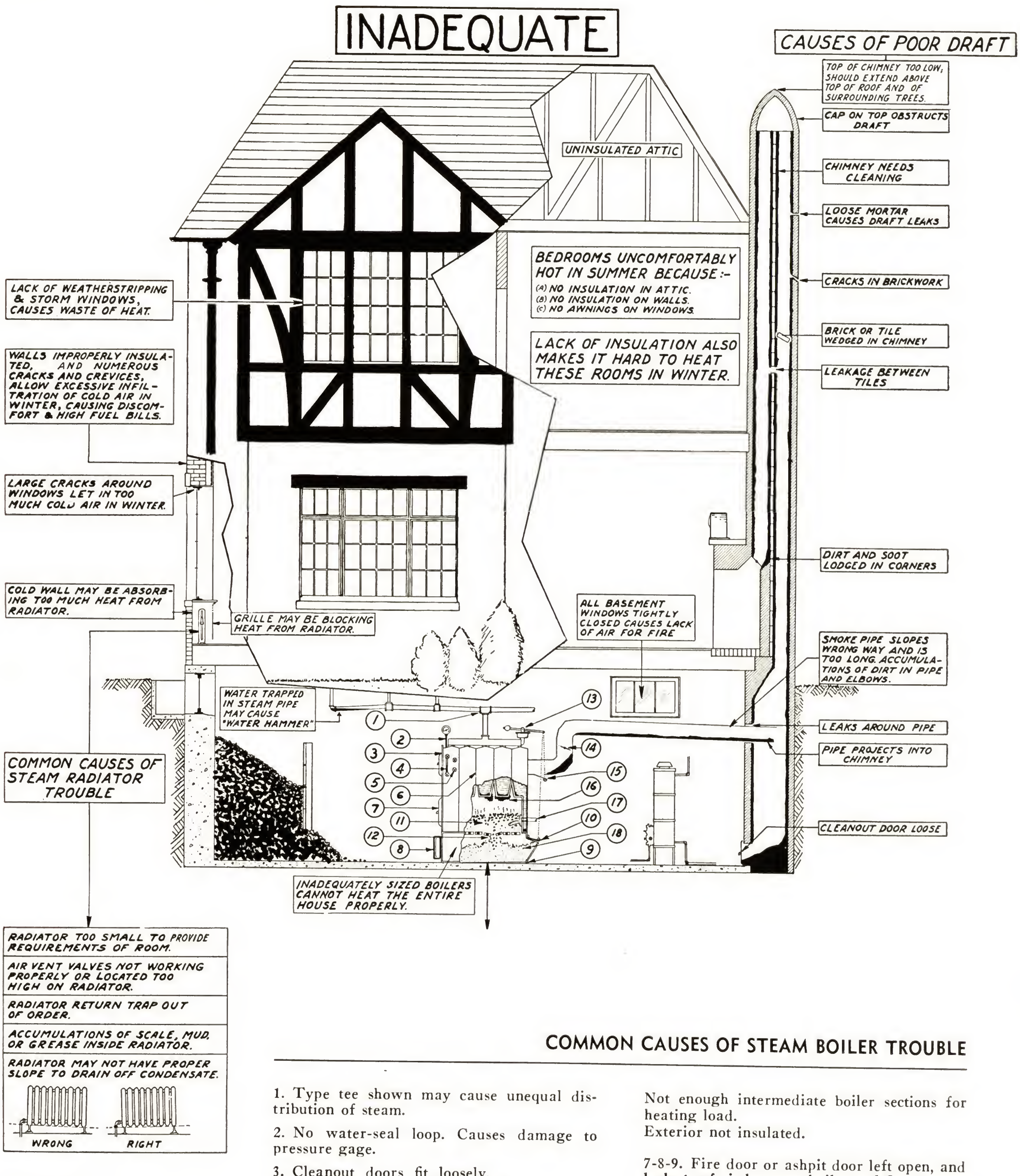
The following figures are of interest in showing the heating requirements in each month of a normal season as expressed as a per cent of total annual requirements. The cumulative fuel requirements up to the first of each month are also shown.

HEATING REQUIREMENTS BY MONTHS

(Computed for Philadelphia and New York
but applicable in general to Anthracite territory)

	Monthly Heat or Fuel Requirement	*Cumulative to Last Day of Month*
October	5%	5%
November	12%	17%
December	18%	35%
January	20%	55%
February	18%	73%
March	16%	89%
April	9%	98%
May	2%	100%

As an example, the table shows that as of December 31st, 35% of the heating season has passed, thus if 3½ tons have been used prior to January 1st, 6½ tons or 65% may be estimated as the further requirements for the remainder of the season.


INADEQUATE
CAUSES OF POOR DRAFT
TOP OF CHIMNEY TOO LOW, SHOULD EXTEND ABOVE TOP OF ROOF AND OF SURROUNDING TREES.
CAP ON TOP OBSTRUCTS DRAFT
CHIMNEY NEEDS CLEANING
LOOSE MORTAR CAUSES DRAFT LEAKS
CRACKS IN BRICKWORK
BRICK OR TILE WEDGED IN CHIMNEY
LEAKAGE BETWEEN TILES
DIRT AND SOOT LODGED IN CORNERS
SMOKE PIPE SLOPES WRONG WAY AND IS TOO LONG. ACCUMULATIONS OF DIRT IN PIPE AND ELBOWS.
LEAKS AROUND PIPE
PIPE PROJECTS INTO CHIMNEY
CLEANOUT DOOR LOOSE
UNINSULATED ATTIC
BEDROOMS UNCOMFORTABLY HOT IN SUMMER BECAUSE:-
(A) NO INSULATION IN ATTIC.
(B) NO INSULATION ON WALLS.
(C) NO AWNINGS ON WINDOWS.
LACK OF INSULATION ALSO MAKES IT HARD TO HEAT THESE ROOMS IN WINTER.
LACK OF WEATHERSTRIPPING & STORM WINDOWS, CAUSES WASTE OF HEAT.
WALLS IMPROPERLY INSULATED, AND NUMEROUS CRACKS AND CREVICES, ALLOW EXCESSIVE INFILTRATION OF COLD AIR IN WINTER, CAUSING DISCOMFORT & HIGH FUEL BILLS.
LARGE CRACKS AROUND WINDOWS LET IN TOO MUCH COLD AIR IN WINTER.
COLD WALL MAY BE ABSORBING TOO MUCH HEAT FROM RADIATOR.
GRILLE MAY BE BLOCKING HEAT FROM RADIATOR.
ALL BASEMENT WINDOWS TIGHTLY CLOSED CAUSES LACK OF AIR FOR FIRE
WATER TRAPPED IN STEAM PIPE MAY CAUSE "WATER HAMMER"
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COMMON CAUSES OF STEAM RADIATOR TROUBLE
INADEQUATELY SIZED BOILERS CANNOT HEAT THE ENTIRE HOUSE PROPERLY.
RADIATOR TOO SMALL TO PROVIDE REQUIREMENTS OF ROOM.
AIR VENT VALVES NOT WORKING PROPERLY OR LOCATED TOO HIGH ON RADIATOR.
RADIATOR RETURN TRAP OUT OF ORDER.
ACCUMULATIONS OF SCALE, MUD, OR GREASE INSIDE RADIATOR.
RADIATOR MAY NOT HAVE PROPER SLOPE TO DRAIN OFF CONDENSATE.
WRONG
RIGHT

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COMMON CAUSES OF STEAM BOILER TROUBLE

1. Type tee shown may cause unequal distribution of steam.

2. No water-seal loop. Causes damage to pressure gage.

3. Cleanout doors fit loosely.
Flue passages may need cleaning.

4. Gage glass dirty, making it hard to observe level of water.
Gage glass valves closed or in poor condition.

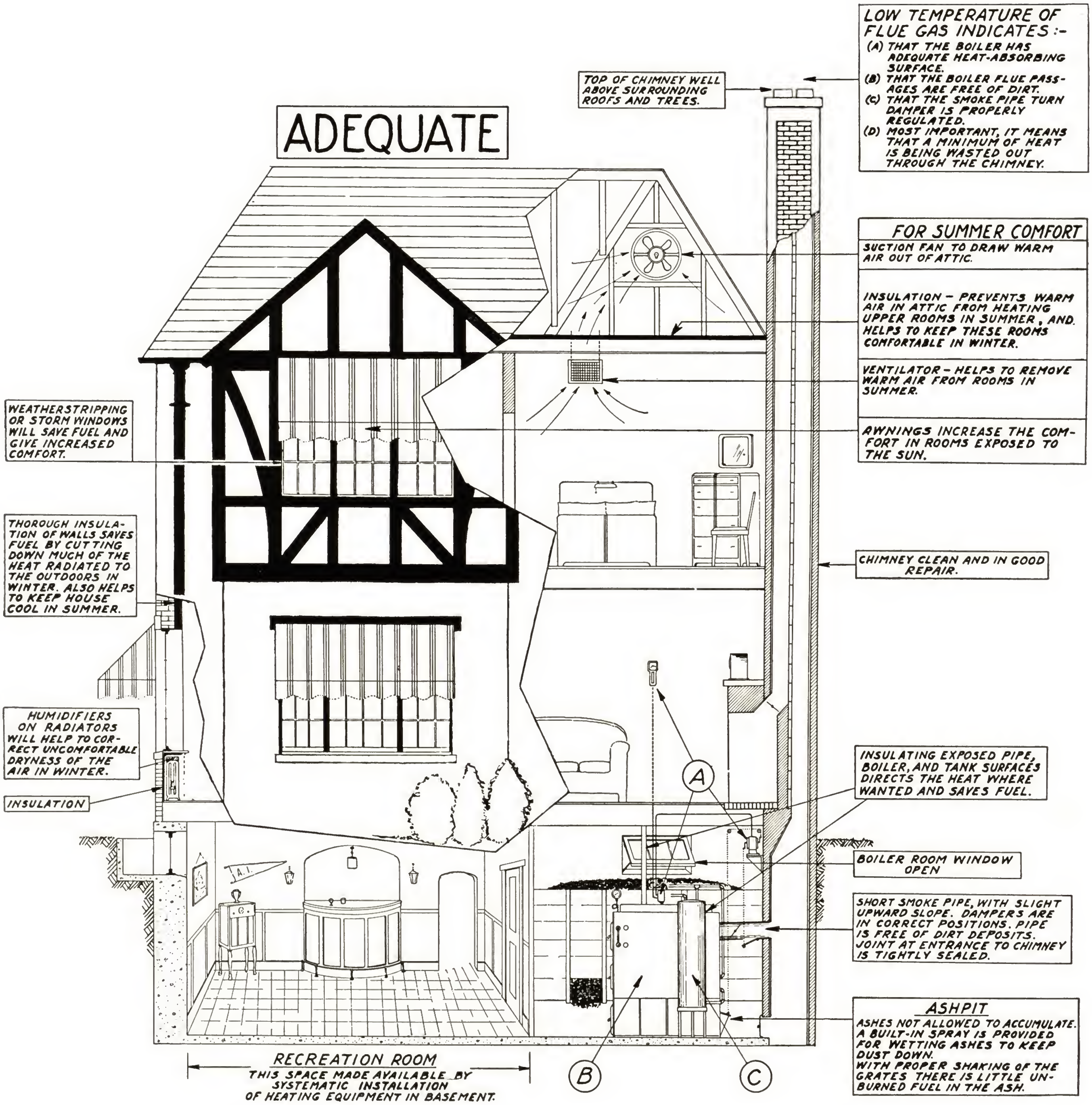
5. Try-cocks plugged up.

6. Loose joints between boiler sections due to furnace cement becoming dislodged, or sections not installed in proper sequence, cause hot gas to be by-passed prematurely to chimney.
Not enough intermediate boiler sections for heating load.
Exterior not insulated.

7-8-9. Fire door or ashpit door left open, and **leakage of air between boiler and floor causes** poor draft regulation. Slide damper on fire door should usually be partly open.

10. Ashpit damper does not close properly.

11. Size of fuel used may not be suited to size and depth of firebox.
Clinkers formed due to poking fire from top, burning garbage on it, too thin fuel bed, faulty banking, or excessive burning rate.


ADEQUATE
TOP OF CHIMNEY WELL ABOVE SURROUNDING ROOFS AND TREES.
LOW TEMPERATURE OF FLUE GAS INDICATES :-
(A) THAT THE BOILER HAS ADEQUATE HEAT-ABSORBING SURFACE.
(B) THAT THE BOILER FLUE PASSAGES ARE FREE OF DIRT.
(C) THAT THE SMOKE PIPE TURN DAMPER IS PROPERLY REGULATED.
(D) MOST IMPORTANT, IT MEANS THAT A MINIMUM OF HEAT IS BEING WASTED OUT THROUGH THE CHIMNEY.
FOR SUMMER COMFORT
SUCTION FAN TO DRAW WARM AIR OUT OF ATTIC.
INSULATION – PREVENTS WARM AIR IN ATTIC FROM HEATING UPPER ROOMS IN SUMMER, AND HELPS TO KEEP THESE ROOMS COMFORTABLE IN WINTER.
VENTILATOR – HELPS TO REMOVE WARM AIR FROM ROOMS IN SUMMER.
AWNINGS INCREASE THE COMFORT IN ROOMS EXPOSED TO THE SUN.
WEATHERSTRIPPING OR STORM WINDOWS WILL SAVE FUEL AND GIVE INCREASED COMFORT.
THOROUGH INSULATION OF WALLS SAVES FUEL BY CUTTING DOWN MUCH OF THE HEAT RADIATED TO THE OUTDOORS IN WINTER. ALSO HELPS TO KEEP HOUSE COOL IN SUMMER.
CHIMNEY CLEAN AND IN GOOD REPAIR.
HUMIDIFIERS ON RADIATORS WILL HELP TO CORRECT UNCOMFORTABLE DRYNESS OF THE AIR IN WINTER.
INSULATION
INSULATING EXPOSED PIPE, BOILER, AND TANK SURFACES DIRECTS THE HEAT WHERE WANTED AND SAVES FUEL.
A
BOILER ROOM WINDOW OPEN
SHORT SMOKE PIPE, WITH SLIGHT UPWARD SLOPE. DAMPERS ARE IN CORRECT POSITIONS. PIPE IS FREE OF DIRT DEPOSITS. JOINT AT ENTRANCE TO CHIMNEY IS TIGHTLY SEALED.
ASHPIT
ASHES NOT ALLOWED TO ACCUMULATE. A BUILT-IN SPRAY IS PROVIDED FOR WETTING ASHES TO KEEP DUST DOWN. WITH PROPER SHAKING OF THE GRATES THERE IS LITTLE UNBURNED FUEL IN THE ASH.
A.I.
RECREATION ROOM
THIS SPACE MADE AVAILABLE BY SYSTEMATIC INSTALLATION OF HEATING EQUIPMENT IN BASEMENT.
B
C

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12. Grates burned and warped or not suited to size of fuel used, cause waste of fuel.

13. Draft regulator not adjusted properly.

14–15. Turn and check dampers in wrong places. Turn damper should be between check damper and boiler, and should not be open wider than is necessary.

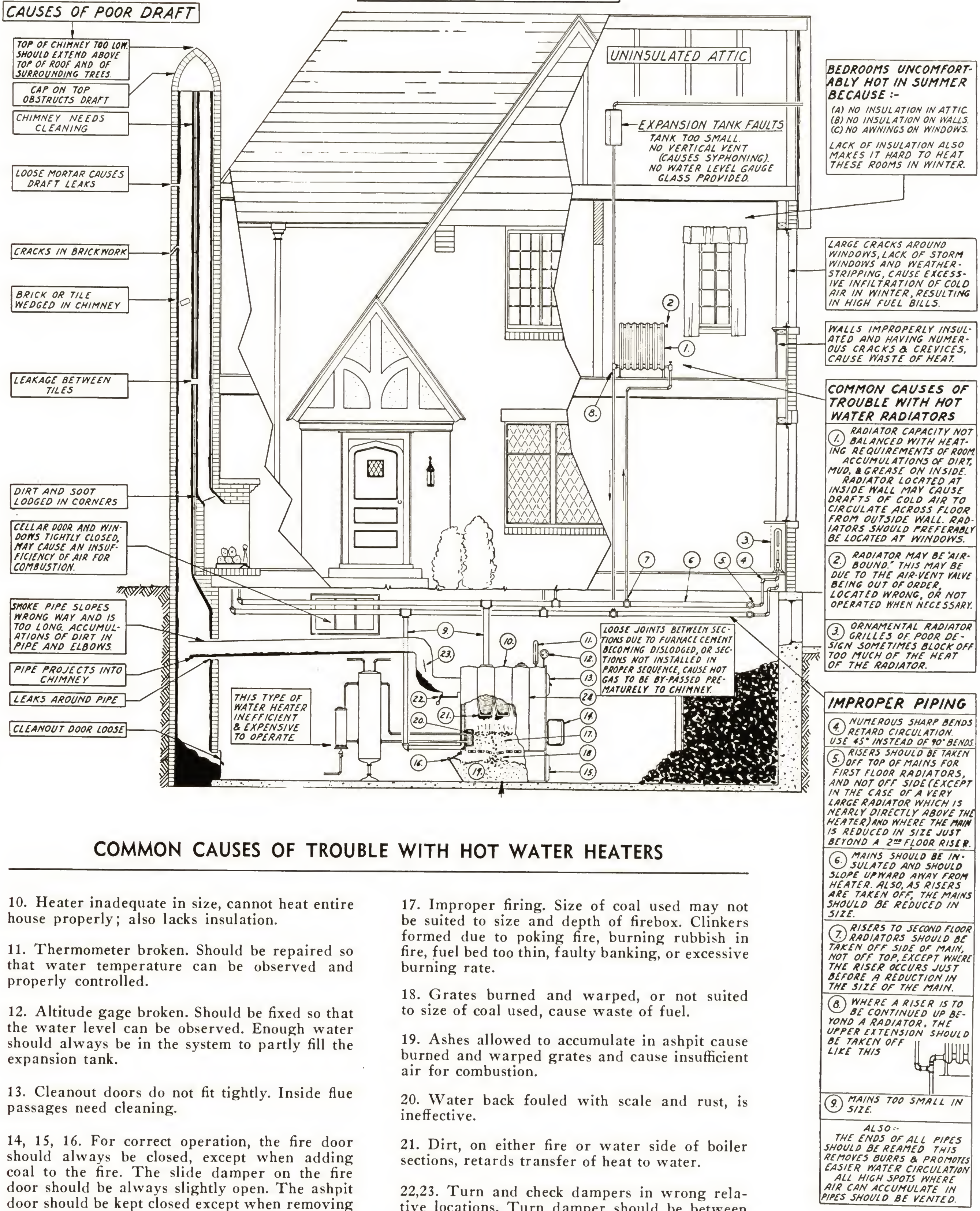
16. Dirt, either on water or fire side of boiler sections, retards transfer of heat to water.

17. Water back fouled with scale and rust, is ineffective.

18. Ashes allowed to accumulate in ashpit, burn and warp grates, and cause insufficiency of air for combustion.

HEATING HEALTH CHART
STEAM AND VAPOR SYSTEMS

INADEQUATE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CHIMNEY NEEDS CLEANING
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CRACKS IN BRICKWORK
BRICK OR TILE WEDGED IN CHIMNEY
LEAKAGE BETWEEN TILES
DIRT AND SOOT LODGED IN CORNERS
CELLAR DOOR AND WINDOWS TIGHTLY CLOSED, MAY CAUSE AN INSUFFICIENCY OF AIR FOR COMBUSTION.
SMOKE PIPE SLOPES WRONG WAY AND IS TOO LONG. ACCUMULATIONS OF DIRT IN PIPE AND ELBOWS.
PIPE PROJECTS INTO CHIMNEY
LEAKS AROUND PIPE
CLEANOUT DOOR LOOSE
UNINSULATED ATTIC
EXPANSION TANK FAULTS
TANK TOO SMALL.
NO VERTICAL VENT (CAUSES SYPHONING).
NO WATER LEVEL GAUGE GLASS PROVIDED.
THIS TYPE OF WATER HEATER INEFFICIENT & EXPENSIVE TO OPERATE
LOOSE JOINTS BETWEEN SECTIONS DUE TO FURNACE CEMENT BECOMING DISLODGED, OR SECTIONS NOT INSTALLED IN PROPER SEQUENCE, CAUSE HOT GAS TO BE BY-PASSED PREMATURELY TO CHIMNEY.
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BEDROOMS UNCOMFORTABLY HOT IN SUMMER BECAUSE :-
(A) NO INSULATION IN ATTIC.
(B) NO INSULATION ON WALLS.
(C) NO AWNINGS ON WINDOWS.
LACK OF INSULATION ALSO MAKES IT HARD TO HEAT THESE ROOMS IN WINTER.
LARGE CRACKS AROUND WINDOWS, LACK OF STORM WINDOWS AND WEATHER-STRIPPING, CAUSE EXCESSIVE INFILTRATION OF COLD AIR IN WINTER, RESULTING IN HIGH FUEL BILLS.
WALLS IMPROPERLY INSULATED AND HAVING NUMEROUS CRACKS & CREVICES, CAUSE WASTE OF HEAT.
COMMON CAUSES OF TROUBLE WITH HOT WATER RADIATORS
(1.) RADIATOR CAPACITY NOT BALANCED WITH HEATING REQUIREMENTS OF ROOM. ACCUMULATIONS OF DIRT, MUD, & GREASE ON INSIDE. RADIATOR LOCATED AT INSIDE WALL MAY CAUSE DRAFTS OF COLD AIR TO CIRCULATE ACROSS FLOOR FROM OUTSIDE WALL. RADIATORS SHOULD PREFERABLY BE LOCATED AT WINDOWS.
(2.) RADIATOR MAY BE "AIR-BOUND." THIS MAY BE DUE TO THE AIR-VENT VALVE BEING OUT OF ORDER, LOCATED WRONG, OR NOT OPERATED WHEN NECESSARY.
(3.) ORNAMENTAL RADIATOR GRILLES OF POOR DESIGN SOMETIMES BLOCK OFF TOO MUCH OF THE HEAT OF THE RADIATOR.
IMPROPER PIPING
(4.) NUMEROUS SHARP BENDS RETARD CIRCULATION. USE 45° INSTEAD OF 90° BENDS.
(5.) RISERS SHOULD BE TAKEN OFF TOP OF MAINS FOR FIRST FLOOR RADIATORS, AND NOT OFF SIDE (EXCEPT IN THE CASE OF A VERY LARGE RADIATOR WHICH IS NEARLY DIRECTLY ABOVE THE HEATER) AND WHERE THE MAIN IS REDUCED IN SIZE JUST BEYOND A 2ND FLOOR RISER.
(6.) MAINS SHOULD BE INSULATED AND SHOULD SLOPE UPWARD AWAY FROM HEATER. ALSO, AS RISERS ARE TAKEN OFF, THE MAINS SHOULD BE REDUCED IN SIZE.
(7.) RISERS TO SECOND FLOOR RADIATORS SHOULD BE TAKEN OFF SIDE OF MAIN, NOT OFF TOP, EXCEPT WHERE THE RISER OCCURS JUST BEFORE A REDUCTION IN THE SIZE OF THE MAIN.
(8.) WHERE A RISER IS TO BE CONTINUED UP BEYOND A RADIATOR, THE UPPER EXTENSION SHOULD BE TAKEN OFF LIKE THIS
(9.) MAINS TOO SMALL IN SIZE.
ALSO:-
THE ENDS OF ALL PIPES SHOULD BE REAMED. THIS REMOVES BURRS & PROMOTES EASIER WATER CIRCULATION.
ALL HIGH SPOTS WHERE AIR CAN ACCUMULATE IN PIPES SHOULD BE VENTED.

COMMON CAUSES OF TROUBLE WITH HOT WATER HEATERS

10. Heater inadequate in size, cannot heat entire house properly; also lacks insulation.

11. Thermometer broken. Should be repaired so that water temperature can be observed and properly controlled.

12. Altitude gage broken. Should be fixed so that the water level can be observed. Enough water should always be in the system to partly fill the expansion tank.

13. Cleanout doors do not fit tightly. Inside flue passages need cleaning.

14, 15, 16. For correct operation, the fire door should always be closed, except when adding coal to the fire. The slide damper on the fire door should be always slightly open. The ashpit door should be kept closed except when removing ashes. During the day the ashpit damper may be left open, and drafts controlled by the check damper alone. During the night it is usually necessary to close the ashpit damper in order to bank the fire.

17. Improper firing. Size of coal used may not be suited to size and depth of firebox. Clinkers formed due to poking fire, burning rubbish in fire, fuel bed too thin, faulty banking, or excessive burning rate.

18. Grates burned and warped, or not suited to size of coal used, cause waste of fuel.

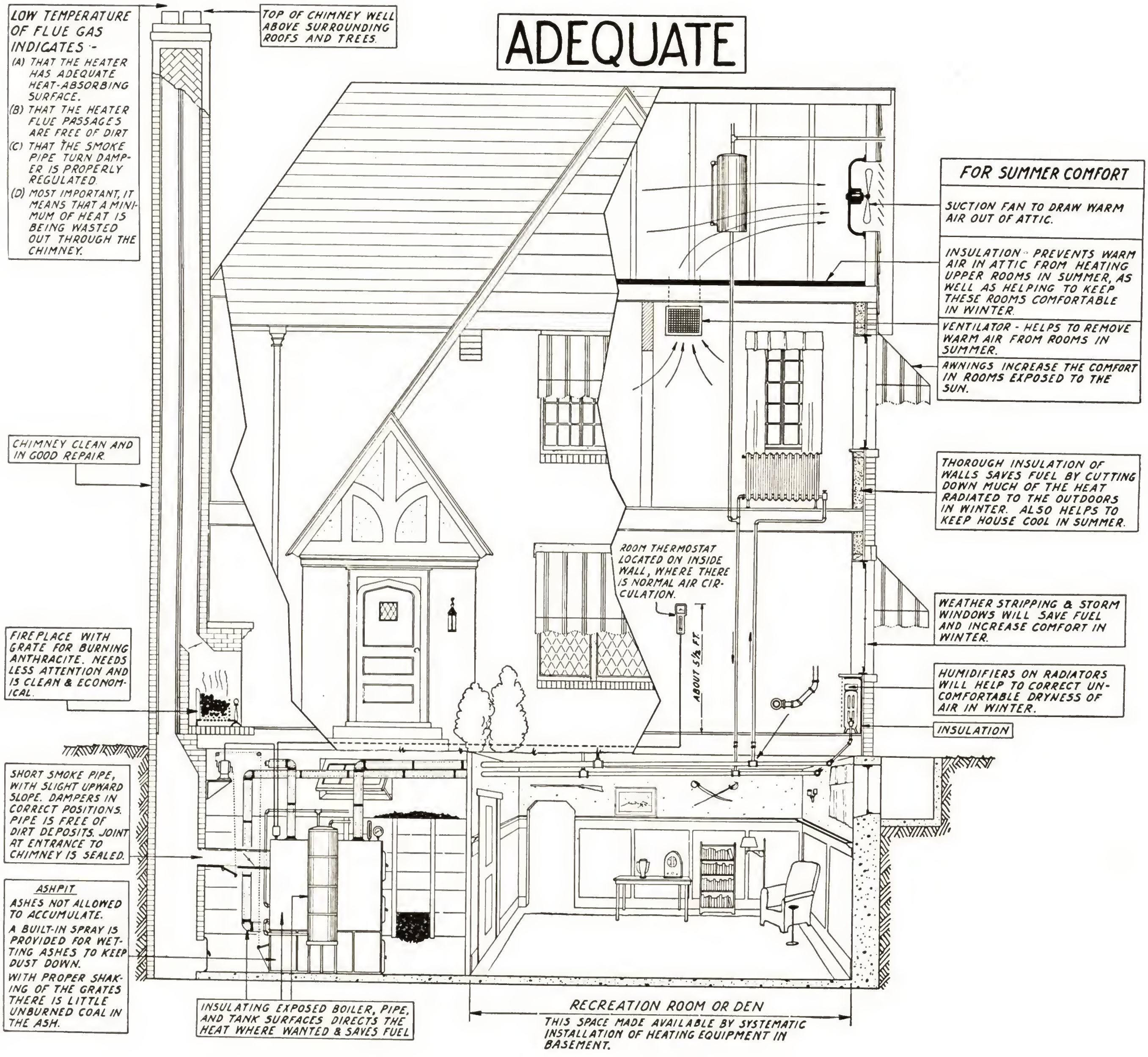
19. Ashes allowed to accumulate in ashpit cause burned and warped grates and cause insufficient air for combustion.

20. Water back fouled with scale and rust, is ineffective.

21. Dirt, on either fire or water side of boiler sections, retards transfer of heat to water.

22,23. Turn and check dampers in wrong relative locations. Turn damper should be between check damper and heater. Turn damper should be adjusted to as near the closed position as possible.

24. Joints between boiler sections not tight.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TOP OF CHIMNEY WELL ABOVE SURROUNDING ROOFS AND TREES.
FOR SUMMER COMFORT
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CHIMNEY CLEAN AND IN GOOD REPAIR.
THOROUGH INSULATION OF WALLS SAVES FUEL BY CUTTING DOWN MUCH OF THE HEAT RADIATED TO THE OUTDOORS IN WINTER. ALSO HELPS TO KEEP HOUSE COOL IN SUMMER.
ROOM THERMOSTAT LOCATED ON INSIDE WALL, WHERE THERE IS NORMAL AIR CIRCULATION.
ABOUT 5½ FT.
WEATHER STRIPPING & STORM WINDOWS WILL SAVE FUEL AND INCREASE COMFORT IN WINTER.
FIREPLACE WITH GRATE FOR BURNING ANTHRACITE. NEEDS LESS ATTENTION AND IS CLEAN & ECONOMICAL.
HUMIDIFIERS ON RADIATORS WILL HELP TO CORRECT UNCOMFORTABLE DRYNESS OF AIR IN WINTER.
INSULATION
SHORT SMOKE PIPE, WITH SLIGHT UPWARD SLOPE. DAMPERS IN CORRECT POSITIONS. PIPE IS FREE OF DIRT DEPOSITS. JOINT AT ENTRANCE TO CHIMNEY IS SEALED.
ASHPIT
ASHES NOT ALLOWED TO ACCUMULATE.
A BUILT-IN SPRAY IS PROVIDED FOR WETTING ASHES TO KEEP DUST DOWN.
WITH PROPER SHAKING OF THE GRATES THERE IS LITTLE UNBURNED COAL IN THE ASH.
INSULATING EXPOSED BOILER, PIPE, AND TANK SURFACES DIRECTS THE HEAT WHERE WANTED & SAVES FUEL
RECREATION ROOM OR DEN
THIS SPACE MADE AVAILABLE BY SYSTEMATIC INSTALLATION OF HEATING EQUIPMENT IN BASEMENT.

"CLOSED" HOT WATER SYSTEMS

The above illustrations are based on an "open" two-pipe gravity system, with the expansion tank located at least 2 feet above the highest radiator in the system and connected to a return riser. The top of the expansion tank has an open overflow pipe so that no pressure can build up in the system. In such systems the customary water temperature is about 180°.

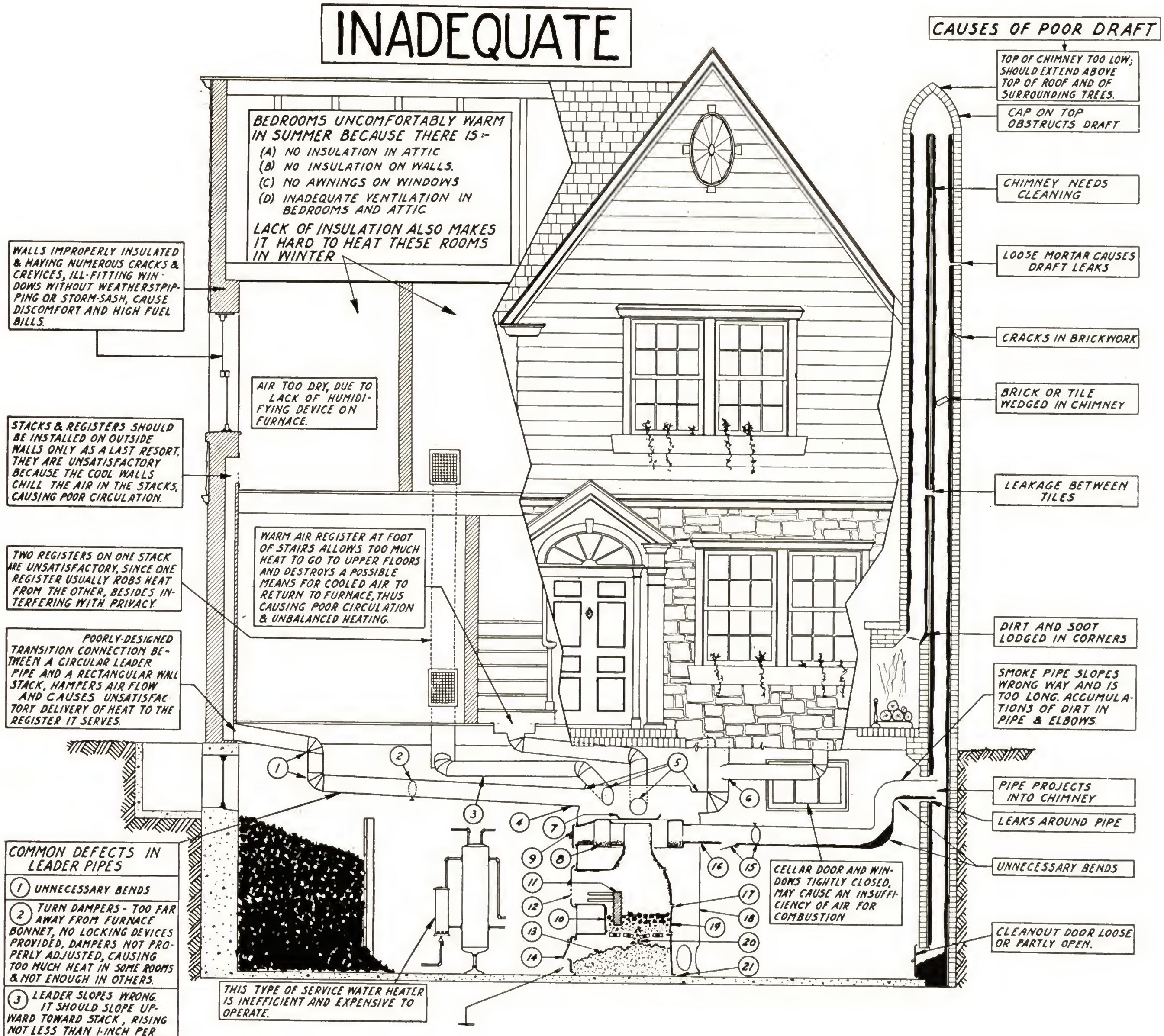
In a closed system, a water pressure of about 10 lbs. is allowed to build up, which means that a higher water temperature (220° to 240°) can be maintained. This higher temperature makes it possible to use smaller pipes and radiators than would be required with 180° water, which means a saving in initial cost of new installations. It is also possible at a relatively small expense to increase the heating effectiveness of an open system by converting it to a closed system.

On closed systems the expansion tank is usually connected into the return main in the basement. Expansion and contraction of the body of water in the system is taken up by the resilient "cushion" of air under pressure in the expansion tank. A pressure-relief valve must always be installed (usually in the line connecting the expansion tank to the return main) to prevent dangerous pressures in excess of 30 lbs. from building up in the system.

HEATING HEALTH CHART

HOT WATER SYSTEMS

INADEQUATE



BEDROOMS UNCOMFORTABLY WARM IN SUMMER BECAUSE THERE IS:-
- (A) NO INSULATION IN ATTIC
- (B) NO INSULATION ON WALLS.
- (C) NO AWNINGS ON WINDOWS
- (D) INADEQUATE VENTILATION IN BEDROOMS AND ATTIC

LACK OF INSULATION ALSO MAKES IT HARD TO HEAT THESE ROOMS IN WINTER

WALLS IMPROPERLY INSULATED & HAVING NUMEROUS CRACKS & CREVICES, ILL-FITTING WINDOWS WITHOUT WEATHERSTPIPPING OR STORM-SASH, CAUSE DISCOMFORT AND HIGH FUEL BILLS.

AIR TOO DRY, DUE TO LACK OF HUMIDIFYING DEVICE ON FURNACE.

STACKS & REGISTERS SHOULD BE INSTALLED ON OUTSIDE WALLS ONLY AS A LAST RESORT. THEY ARE UNSATISFACTORY BECAUSE THE COOL WALLS CHILL THE AIR IN THE STACKS, CAUSING POOR CIRCULATION.

TWO REGISTERS ON ONE STACK ARE UNSATISFACTORY, SINCE ONE REGISTER USUALLY ROBS HEAT FROM THE OTHER, BESIDES INTERFERING WITH PRIVACY.

WARM AIR REGISTER AT FOOT OF STAIRS ALLOWS TOO MUCH HEAT TO GO TO UPPER FLOORS AND DESTROYS A POSSIBLE MEANS FOR COOLED AIR TO RETURN TO FURNACE, THUS CAUSING POOR CIRCULATION & UNBALANCED HEATING.

POORLY-DESIGNED TRANSITION CONNECTION BETWEEN A CIRCULAR LEADER PIPE AND A RECTANGULAR WALL STACK, HAMPERS AIR FLOW AND CAUSES UNSATISFACTORY DELIVERY OF HEAT TO THE REGISTER IT SERVES.

THIS TYPE OF SERVICE WATER HEATER IS INEFFICIENT AND EXPENSIVE TO OPERATE.

CELLAR DOOR AND WINDOWS TIGHTLY CLOSED, MAY CAUSE AN INSUFFICIENCY OF AIR FOR COMBUSTION.

CAUSES OF POOR DRAFT

- TOP OF CHIMNEY TOO LOW; SHOULD EXTEND ABOVE TOP OF ROOF AND OF SURROUNDING TREES.
- CAP ON TOP OBSTRUCTS DRAFT
- CHIMNEY NEEDS CLEANING
- LOOSE MORTAR CAUSES DRAFT LEAKS
- CRACKS IN BRICKWORK
- BRICK OR TILE WEDGED IN CHIMNEY
- LEAKAGE BETWEEN TILES
- DIRT AND SOOT LODGED IN CORNERS
- SMOKE PIPE SLOPES WRONG WAY AND IS TOO LONG. ACCUMULATIONS OF DIRT IN PIPE & ELBOWS.
- PIPE PROJECTS INTO CHIMNEY
- LEAKS AROUND PIPE
- UNNECESSARY BENDS
- CLEANOUT DOOR LOOSE OR PARTLY OPEN.

COMMON DEFECTS IN LEADER PIPES

① UNNECESSARY BENDS

② TURN DAMPERS - TOO FAR AWAY FROM FURNACE BONNET, NO LOCKING DEVICES PROVIDED, DAMPERS NOT PROPERLY ADJUSTED, CAUSING TOO MUCH HEAT IN SOME ROOMS & NOT ENOUGH IN OTHERS.

③ LEADER SLOPES WRONG. IT SHOULD SLOPE UPWARD TOWARD STACK, RISING NOT LESS THAN 1-INCH PER RUNNING FOOT. WHERE POSSIBLE, IT IS WELL TO FAVOR THE LONGEST LEADERS AND THOSE SERVING ROOMS DIFFICULT TO HEAT, BY INCREASING THE SLOPE.

④ IT IS POOR PRACTICE TO CONNECT LEADERS TO THAT PORTION OF THE BONNET DIRECTLY ABOVE FIRE DOOR.

⑤ TOPS OF LEADERS SHOULD ALL BE AT SAME ELEVATION (ALL SAME DISTANCE FROM FLOOR) WHERE LEADERS CONNECT INTO BONNET.

⑥ A BRANCH LEADER SHOULD NOT BE TAKEN FROM ANOTHER LEADER.

-IN GENERAL-

LEADERS SHOULD NOT BE LESS THAN 8 INCHES IN DIAMETER.

LEADER DIAMETERS (OR CROSS-SECTIONAL AREAS) THAT ARE OUT OF PROPORTION TO THE HEATING REQUIREMENTS OF THE ROOMS THEY SERVE, CAUSE UNEVEN HOUSE HEATING.

IT IS POOR PRACTICE TO HAVE LEADERS MORE THAN 12 FEET LONG.

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ANTHRACITE INSTITUTE
PRIMOS, PA.

COMMON CAUSES OF TROUBLE WITH PIPED WARM AIR FURNACES

7. No water in humidifier pan causes uncomfortable dryness of air in rooms.

8. Accumulations of dust and fly-ash on walls of combustion chamber and radiator section cause poor heat transfer.

9. Cleanout door loose or partly open. Should be tightly closed.

10. Furnace capacity too small to heat house satisfactorily.

11. Water back is ineffective when fouled with rust and scale.

12, 14. For correct operation, the fire door should always be closed, except when adding coal to the fire. The slide damper on the fire door should be always slightly open. The ashpit door should be kept closed except when removing ashes. During the day the ashpit damper may be left open and drafts controlled by the check damper only. At night it is usually necessary to close the ashpit damper in order to bank the fire.

13. Ashes allowed to accumulate in ashpit cause burning and warping of the grates and lack of air for combustion.

15. Turn and check dampers in wrong relative locations. Turn damper should be between check damper and furnace. Turn damper should be kept as near to the closed position as is practical for satisfactory combustion.

16. Leaks at joints where smokepipe and leaders enter case.

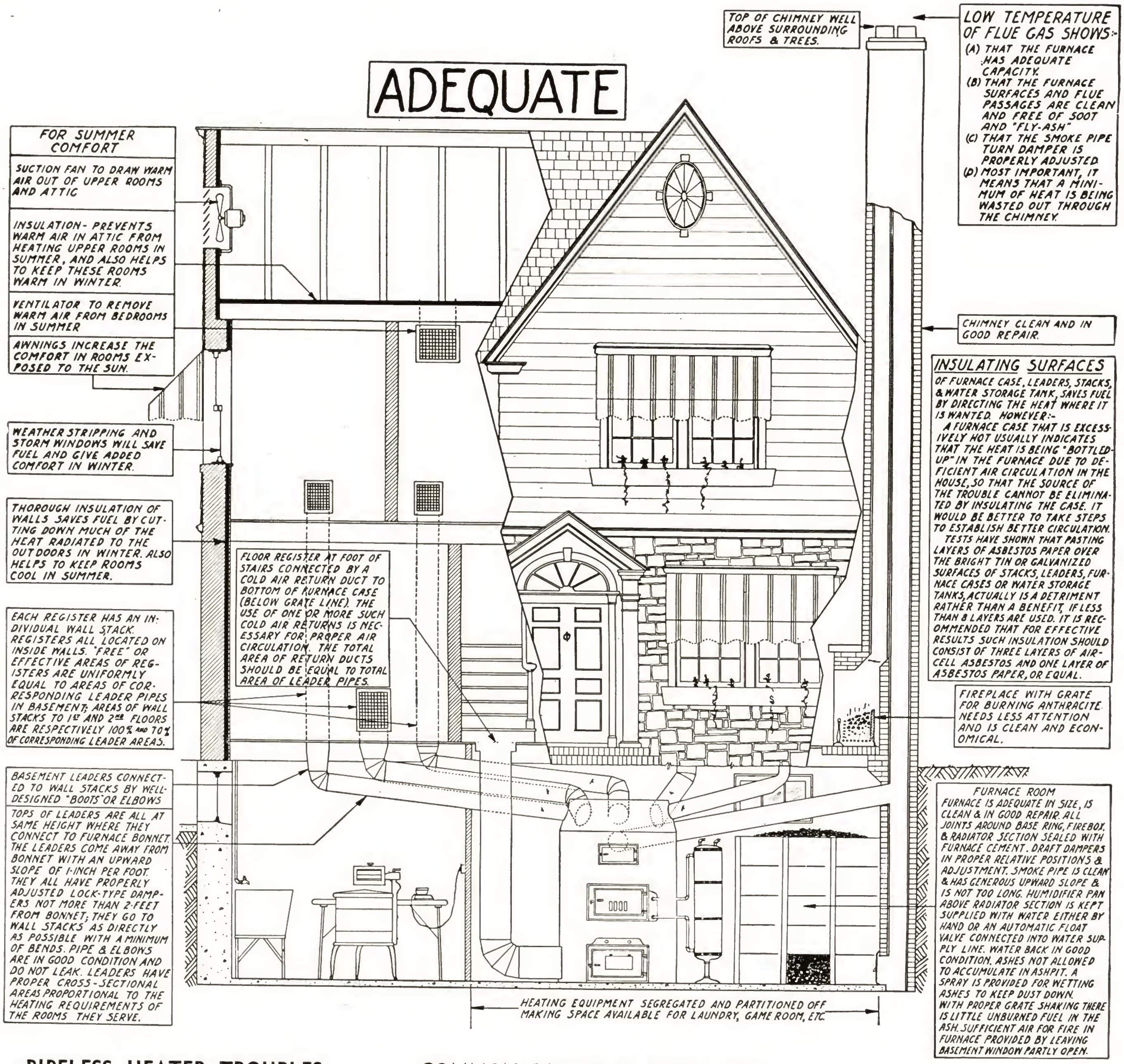
17. Open cracks and leaks at joints in furnace castings cause obnoxious combustion gases to escape into rooms.

18. Case too hot. Usually indicates poor air circulation in the house.

19. Improper firing. Size of coal used may not be suited to diameter and depth of firebox. Clinkers formed due to poking fire, burning rubbish on it, fuel bed too thin, faulty banking, or excessive burning rate.

20. Grates burned and warped, or not suited to size of coal, cause waste of fuel.

21. Base ring not tightly sealed, causing air leakage.



TOP OF CHIMNEY WELL ABOVE SURROUNDING ROOFS & TREES.

LOW TEMPERATURE OF FLUE GAS SHOWS:-
(A) THAT THE FURNACE HAS ADEQUATE CAPACITY.
(B) THAT THE FURNACE SURFACES AND FLUE PASSAGES ARE CLEAN AND FREE OF SOOT AND "FLY-ASH"
(C) THAT THE SMOKE PIPE TURN DAMPER IS PROPERLY ADJUSTED
(D) MOST IMPORTANT, IT MEANS THAT A MINIMUM OF HEAT IS BEING WASTED OUT THROUGH THE CHIMNEY.

FOR SUMMER COMFORT

SUCTION FAN TO DRAW WARM AIR OUT OF UPPER ROOMS AND ATTIC

INSULATION- PREVENTS WARM AIR IN ATTIC FROM HEATING UPPER ROOMS IN SUMMER, AND ALSO HELPS TO KEEP THESE ROOMS WARM IN WINTER.

VENTILATOR TO REMOVE WARM AIR FROM BEDROOMS IN SUMMER

AWNINGS INCREASE THE COMFORT IN ROOMS EXPOSED TO THE SUN.

WEATHER STRIPPING AND STORM WINDOWS WILL SAVE FUEL AND GIVE ADDED COMFORT IN WINTER.

THOROUGH INSULATION OF WALLS SAVES FUEL BY CUTTING DOWN MUCH OF THE HEAT RADIATED TO THE OUTDOORS IN WINTER. ALSO HELPS TO KEEP ROOMS COOL IN SUMMER.

EACH REGISTER HAS AN INDIVIDUAL WALL STACK. REGISTERS ALL LOCATED ON INSIDE WALLS. "FREE" OR EFFECTIVE AREAS OF REGISTERS ARE UNIFORMLY EQUAL TO AREAS OF CORRESPONDING LEADER PIPES IN BASEMENT; AREAS OF WALL STACKS TO 1ST AND 2ND FLOORS ARE RESPECTIVELY 100% AND 70% OF CORRESPONDING LEADER AREAS.

FLOOR REGISTER AT FOOT OF STAIRS CONNECTED BY A COLD AIR RETURN DUCT TO BOTTOM OF FURNACE CASE (BELOW GRATE LINE). THE USE OF ONE OR MORE SUCH COLD AIR RETURNS IS NECESSARY FOR PROPER AIR CIRCULATION. THE TOTAL AREA OF RETURN DUCTS SHOULD BE EQUAL TO TOTAL AREA OF LEADER PIPES.

BASEMENT LEADERS CONNECTED TO WALL STACKS BY WELL-DESIGNED "BOOTS" OR ELBOWS

TOPS OF LEADERS ARE ALL AT SAME HEIGHT WHERE THEY CONNECT TO FURNACE BONNET. THE LEADERS COME AWAY FROM BONNET WITH AN UPWARD SLOPE OF 1-INCH PER FOOT. THEY ALL HAVE PROPERLY ADJUSTED LOCK-TYPE DAMPERS NOT MORE THAN 2-FEET FROM BONNET; THEY GO TO WALL STACKS AS DIRECTLY AS POSSIBLE WITH A MINIMUM OF BENDS. PIPE & ELBOWS ARE IN GOOD CONDITION AND DO NOT LEAK. LEADERS HAVE PROPER CROSS-SECTIONAL AREAS PROPORTIONAL TO THE HEATING REQUIREMENTS OF THE ROOMS THEY SERVE.

CHIMNEY CLEAN AND IN GOOD REPAIR.

INSULATING SURFACES OF FURNACE CASE, LEADERS, STACKS, & WATER STORAGE TANK, SAVES FUEL BY DIRECTING THE HEAT WHERE IT IS WANTED. HOWEVER:-

A FURNACE CASE THAT IS EXCESSIVELY HOT USUALLY INDICATES THAT THE HEAT IS BEING "BOTTLED-UP" IN THE FURNACE DUE TO DEFICIENT AIR CIRCULATION IN THE HOUSE, SO THAT THE SOURCE OF THE TROUBLE CANNOT BE ELIMINATED BY INSULATING THE CASE. IT WOULD BE BETTER TO TAKE STEPS TO ESTABLISH BETTER CIRCULATION.

TESTS HAVE SHOWN THAT PASTING LAYERS OF ASBESTOS PAPER OVER THE BRIGHT TIN OR GALVANIZED SURFACES OF STACKS, LEADERS, FURNACE CASES OR WATER STORAGE TANKS, ACTUALLY IS A DETRIMENT RATHER THAN A BENEFIT, IF LESS THAN 8 LAYERS ARE USED. IT IS RECOMMENDED THAT FOR EFFECTIVE RESULTS SUCH INSULATION SHOULD CONSIST OF THREE LAYERS OF AIR-CELL ASBESTOS AND ONE LAYER OF ASBESTOS PAPER, OR EQUAL.

FIREPLACE WITH GRATE FOR BURNING ANTHRACITE. NEEDS LESS ATTENTION AND IS CLEAN AND ECONOMICAL.

FURNACE ROOM

FURNACE IS ADEQUATE IN SIZE, IS CLEAN & IN GOOD REPAIR. ALL JOINTS AROUND BASE RING, FIREBOX, & RADIATOR SECTION SEALED WITH FURNACE CEMENT. DRAFT DAMPERS IN PROPER RELATIVE POSITIONS & ADJUSTMENT. SMOKE PIPE IS CLEAN & HAS GENEROUS UPWARD SLOPE & IS NOT TOO LONG. HUMIDIFIER PAN ABOVE RADIATOR SECTION IS KEPT SUPPLIED WITH WATER EITHER BY HAND OR AN AUTOMATIC FLOAT VALVE CONNECTED INTO WATER SUPPLY LINE. WATER BACK IN GOOD CONDITION. ASHES NOT ALLOWED TO ACCUMULATE IN ASHPIT. A SPRAY IS PROVIDED FOR WETTING ASHES TO KEEP DUST DOWN.
WITH PROPER GRATE SHAKING THERE IS LITTLE UNBURNED FUEL IN THE ASH. SUFFICIENT AIR FOR FIRE IN FURNACE PROVIDED BY LEAVING BASEMENT WINDOW PARTLY OPEN.

HEATING EQUIPMENT SEGREGATED AND PARTITIONED OFF MAKING SPACE AVAILABLE FOR LAUNDRY, GAME ROOM, ETC.

PIPELESS HEATER TROUBLES

(A) Heater not suitable for type of house. Pipeless heater should not be installed in houses having a length or width greater than 40 ft. or having isolated rooms to which air circulates with difficulty. Pipeless systems are relatively inexpensive and are ideal for some houses having a large main room centrally located, for bungalows, stores and churches.

(B) Air circulation. Since there are no pipes to distribute the warm air evenly through the building, it is important that care be used in selecting a location for the heater in the basement. Usually a central location is best (unless it is desired to favor some particular room or rooms). Having the register of the heater located near the foot of an open stairway helps circulation to the second floor. If circulation through the stairway is restricted, a register in the ceiling of a downstairs room will help.

COMMON CAUSES OF POOR HEAT DISTRIBUTION WITH PIPED SYSTEMS

(A) Rooms cold, basement too warm. This is usually due to poor air circulation, causing the warm air to be "bottled-up" in the basement, particularly in systems in which no cold air return ducts are provided to bring the cooled air down to the air inlet of the furnace case from the rooms above.

(B) Too much heat in some rooms, not enough in others. This may be due to leaders, stacks, or registers not being proportionate in size to the requirements of the rooms they serve; to leaders not having adequate upward slope; to leaders being too long; to dampers improperly adjusted; to stacks and registers being installed in outside wall or having two registers on a common wall stack.

(C) Bringing all cold air from the outside through a duct to the bottom of the furnace case, without a recirculating duct from a register on the first floor to the furnace, is very wasteful of heat. The partly-warmed house air should be recirculated.

HEATING HEALTH CHART

WARM AIR SYSTEMS

AUTOMATIC
Anthracite Heat

● THE UP-TO-DATE HOME of today is one of the marvels of the age. Gone is all the drudgery from housekeeping. Every inconvenience has been removed, and the modern home, equipped with many devices of science and engineering, may be enjoyed to the fullest extent.

No more does one have to suffer the inconveniences and illnesses directly traceable to cold, drafty, poorly ventilated rooms. The ultramodern heating system assures plentiful heat and even temperature twenty-four hours a day.

Most of us can recall the faulty flues, the trouble of hand-stoking, and the disagreeable task of ash removal. We can recall, too, that quite frequently the house was cold, and it was not until an inventor turned his attention to the method of automatic heating that these difficulties were at last overcome.

ANTHRACITE—A GOOD RELIABLE FUEL

The ideal heating system of today is one which operates automatically, is especially adapted for burning economical anthracite, and will maintain an even temperature all through the day and night.

Let us first look to the fuel. Anthracite combines four favorable factors: it gives a steady, even heat without any sudden, violent bursts of flame; it is absolutely safe; it is clean, as all the tarry and soot-producing materials have been naturally eliminated from it during its formation throughout the ages; and it is economical, for the use of the lower-priced sizes used in anthracite burners cuts fuel costs anywhere from 25% to 75%.

Today everyone wants even, automatic heat, and it is largely a question of selecting the system which will give the best results in the most economical manner.

THE ANTHRACITE BURNER

The Electric Furnace-Man Burner is especially designed to burn anthracite. It requires no stoking, shaking or fussing with drafts, and its cost of operation and maintenance, aside from its other advantageous features, gives it preeminence in the automatic-heating field.

The actual operation of the burner is quite simple. An automatic conveyor carries the coal by means of a "worm" encased in a tube from the bin to the reservoir in the Electric Furnace-Man itself. From this point it is fed at the desired rate of speed to the lower portion of the fire pot. This method provides for scientific burning of the coal, correct combustion being assured by means of an air tube that carries air to the air holes in the revolving fire pot. Air and coal are supplied automatically in the exact proportion needed to obtain maximum benefit. The coal, too, being preheated by the live coals on top, has the gases driven off and these are burned in rising through the hot coal bed, assuring complete combustion.

THE OLD METHOD WAS WRONG

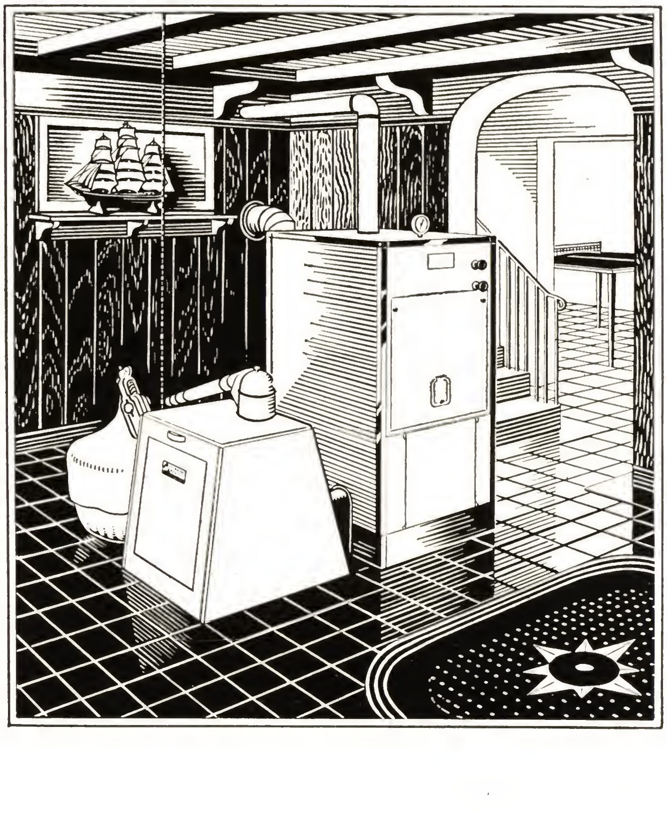
Actually we, and our ancestors before us, had been feeding coal the wrong way! If we'd only stopped to think about it, it would have been obvious. In fact, it was the type of error that stared us in the face every time we put coal on top of the fire. Remember how the fire would die down, and it would be some little time before the "green" or fresh coal would ignite, and how gaseous fumes used to escape unignited up the chimney? That's what was wrong with the old system of hand-firing. There was a consequent drop in temperature, and a resultant loss of heat in the unignited gas fumes. Then, too, when we raked the fire, some of the unburned coal would drop through and be lost beyond recall among the ashes.

STEADY, EVEN HEAT

As this anthracite burner supplies continuous, evenly circulated heat, the heating plant does not have the opportunity to cool to the point where there are layers of cold air near the floor level, with warm air higher in the room. On the other hand, with intermittent heating systems fired by other fuels, once the source of heat is off, the entire system cools. Then, when the thermostat calls for an increase in temperature, the sudden blast occasioned by the fuel being fed sends many heat units wastefully up the chimney.

In operation, there are two types of Electric Furnace-Man models: the hopper types of various capacities which require refilling at intervals, and the bin-feed types which automatically feed the coal from the bin to the burner.

The Electric Furnace-Man, Bin-feed Model, installed in a boiler especially made for it. This is the ideal unit for new homes.

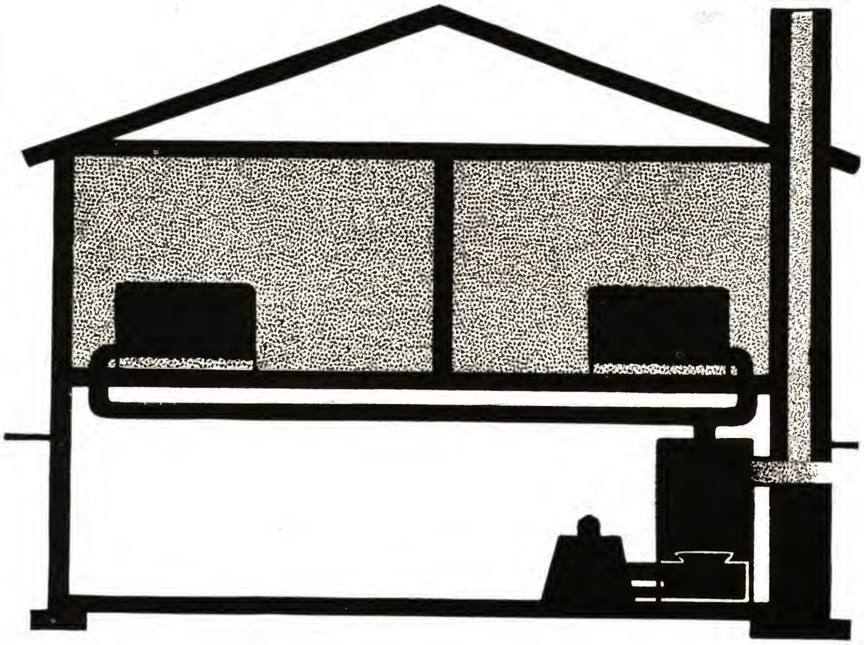


FOR NEW HOMES

For new homes the ideal installation is a complete unit, consisting of the Electric Furnace-Man and a boiler especially made for automatic anthracite-burner firing. The construction of this boiler is such that it transfers heat generated by the burner with maximum efficiency.

The Electric Furnace-Man can also be installed in any type of heating plant in existing homes, whether the system be steam, hot water, vapor or warm air. In such cases this type of burner is ideal, as a furnace or boiler built to burn anthracite was not meant to withstand the sudden, violent temperature changes of other automatic fuels.

Thermostatically controlled, the burner maintains temperature to within a fraction of a degree in all kinds of weather. When an increase in temperature within the house is desirable to offset a drop in the thermometer, coal and air are fed more rapidly to the Electric Furnace-Man, but in such a manner that no sudden extreme is possible. This is a big advantage over the intermittent heat of oil and gas, which is either on full blast or is shut off entirely. Then, too, in view of the continually hot surface of the fire pot, it does not take long to bring up the temperature level to the desired degree.



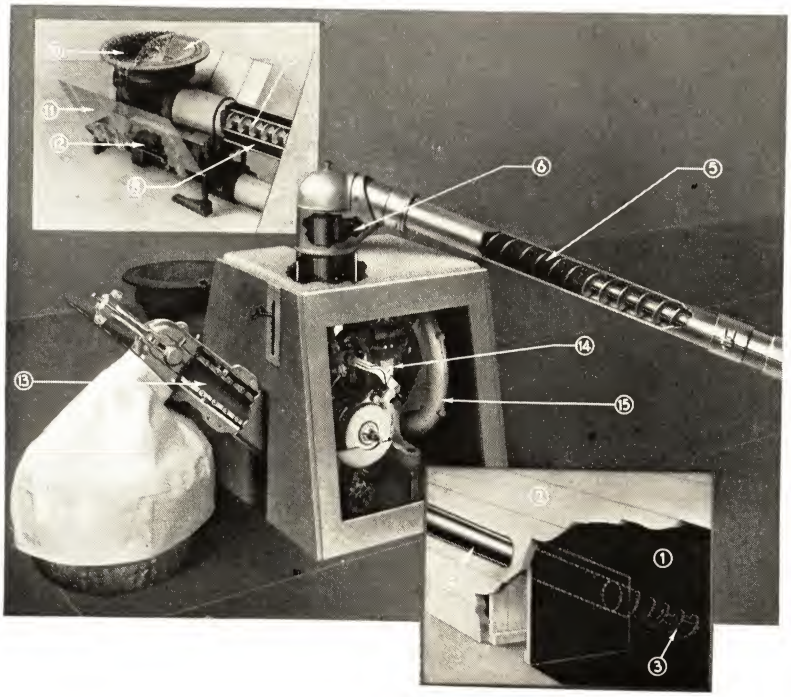
With a steady source of heat from the continuous operation of the Electric Furnace-Man, the heating system is not allowed to cool unduly. There is a steady supply of heat which keeps the air in circulation and prevents the formation of "cold zones" at the lower levels.

Because the heat is produced gradually, as needed, there is a minimum of heat loss up the chimney.

Incidentally, there is little possibility of loss from partially burned and fresh coal being dropped in the ash which is expelled from the top of the fire pot. In other words, before live coal can get to the top of the fire pot it is consumed. Not only does this method permit complete consumption of the heating properties in the coal, but it maintains a permanent hot-top surface to the fire pot. The ash falls from the top of the fire pot to a trough and is automatically and dustlessly conveyed to a covered container.

CUTS FUEL BILLS

Combined with the advantages of complete combustion and even heat is the economy of operation. An analysis of statements by owners of the Electric Furnace-Man Burners shows some interesting conclusive evidence in favor of this automatic anthracite burner. One homeowner who used to



1 RICE *or* BUCKWHEAT COAL
2 COAL BIN
3 BIN-FEED WORM—*automatically carries coal to reservoir*
4 BIN-FEED TUBE
5 COAL *in* BIN-FEED WORM
6 COAL *in* RESERVOIR
7 COAL-FEED WORM—*automatically carries coal to burner*
8 AIR TUBE—*carries air to burner*
9 AIR HOLES *in* REVOLVING FIRE POT
10 BURNING COAL
11 ASH GUIDES
12 ASH-REMOVAL WORM
13 ASH ELEVATOR—*automatically conveys ash to covered container*
14 MOTOR—*operates entire mechanism*
15 FAN—*automatically supplies air for complete combustion*

have an average gas bill of $340 has reduced his fuel bill to $136 since installing the Electric Furnace-Man, and, according to his own statement, he "gets better heat, besides." Another reports having cut his fuel bill, even with the installation of another large radiator and a water-heating unit. Another claims a saving of 40% in his coal bill, compared with the cost of hand-firing. And these are only three typical cases and comments.

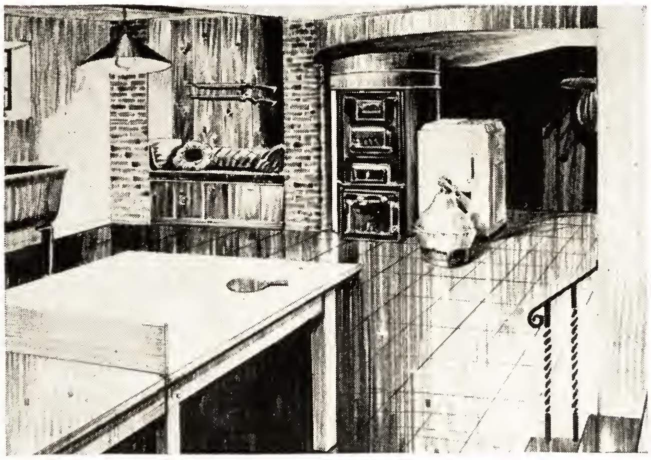
Aside from the efficiency of the Electric Furnace-Man in the home, many industries—such as bakeries, greenhouses, tropical fish hatcheries, and animal incubators—whose very existence is dependent on even, reliable, continuous heat, have installed industrial models, which is an additional proof of the quality, economy and dependability of the Electric Furnace-Man.

As even heat is the basis of air conditioning, and since this burner maintains this desirable factor to a greater extent than any other type of heating system, the Electric Furnace-Man is an ideal foundation for any type of air-conditioning system on the market.

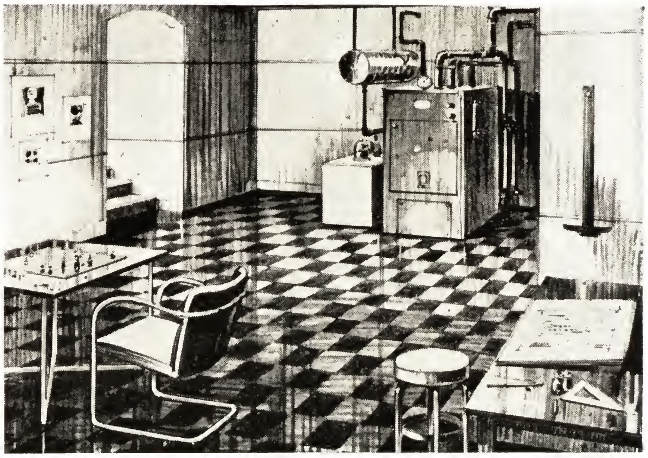
YEAR-ROUND HOT WATER

With the addition of a special attachment the Electric Furnace-Man assures a plentiful supply of hot water throughout the year with both steam and hot-water heating systems. In winter it furnishes hot water at no additional overhead; and in the summertime, for only a few cents a day, averaging from 1/4 to 1/3 less than gas in many instances. The operation of changing over from winter to summer hot water is simplicity itself, for it involves the mere throwing of a switch.

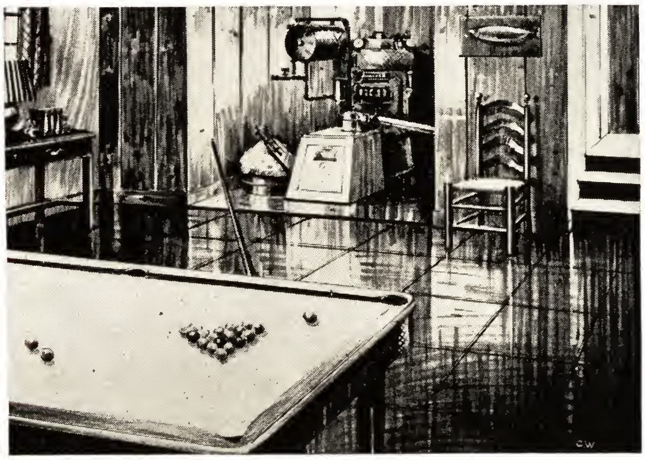
The burner is practically noiseless in operation. The attractive crackle-aluminum cabinet can be installed in the modern basement-gameroom without one being conscious of its presence, especially since coal bins have gone modern, too, and can be cleverly concealed behind artistic paneling.



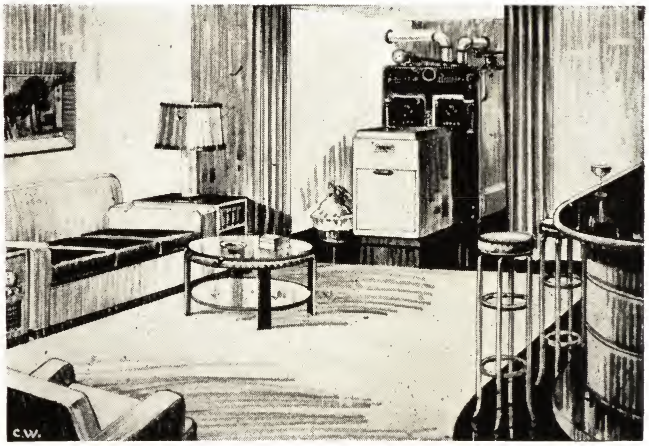
A Hopper Model installed in a warm-air system.



A Bin-feed Model in a two-pipe vapor system, with domestic hot-water supply.



A Bin-feed Model in a one-pipe steam system, with hot-water supply.



A Hopper Model in a gravity hot-water system.

Cooking Becomes a Hobby When Using This Most Unusual STOVE

● THERE IS a new thrill to cooking, now that the Aga Stove is here. Just as we have progressed from the old-time methods of cooking—such as wood fires, the makeshift brick ovens, and the old dirty kitchen coal range—so have we taken another step forward, and this time modern science has produced the Aga. It is a revolutionary method of cooking, scientifically constructed to store up heat and retain it until needed. It is always up to heat; no waiting, no gadgets to turn on or off, no fueling, except once a day.

THE APPEARANCE

The Aga is a most attractive-looking piece of kitchen equipment with its glistening porcelain enamel exterior. Keeping the kitchen stove or range clean has always been the housewife's bane of existence, especially when things boil over and grease splatters out of the frying pan. But with the advent of the Aga Stove, all that drudgery belongs to the past, for there is no boiling over, burning or sticking with this new way of cooking. A damp cloth rubbed over its surface once a day keeps it looking like new.

Not only does the Aga spell "cleanliness", but it is a symbol of modern convenience and comfort. Because of its heavy insulation, the heat is retained inside and does not escape into the kitchen. This means that the kitchen remains as cool and comfortable as the living room. We all know what an overheated kitchen does to a cook's disposition, to say nothing of her appearance.

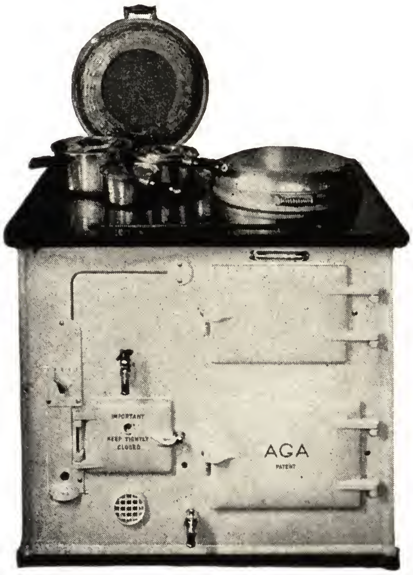
THE PERFORMANCE

When it comes to convenience, the Aga is really something to marvel at. Vegetables, etc., are first brought to a boil on the top hot plate, then placed in the lower oven where they can be forgotten until served. No watching or stirring—you do not "see" them cooking—yet they're so tender and full flavored you wonder how it happened. And how delicious everything is! Even the simplest foods have a flavor you never dreamed of, because their natural juices and flavors are not cooked away, as is the case with old-fashioned cooking methods.

In addition to the hot top plate, there is a second plate of a lower temperature used for simmering and slower cooking. Then there is a very hot oven for baking, roasting, etc. It's really fascinating to cook on an Aga—the combination of using the plates and the ovens gives an elasticity and scope to cooking heretofore impossible.

THE ECONOMY

There are ever so many more features and advantages of this latest contribution to the art of cooking, but one must see it to fully appreciate them. It's economy to own an Aga, too, for it costs virtually nothing to operate—as little as $1.50 per month.



Household Type Stove

Estate Type Stove

A Wholesome, Beneficial Atmosphere for the "HOUSE OF HEALTH"

● OBVIOUSLY, any system that will create and maintain a healthful and beneficial atmosphere indoors should be made a part of the "House of Health." The quality of the air we live in has a marked effect on our general health and vigor. The vitality and buoyancy that we feel in the clean, refreshing air of a balmy day in June is due to the proper balance of temperature, humidity and air movement. It is the purpose of air-conditioning equipment to reproduce these desirable conditions indoors.

During the winter months, where no measures have been taken to maintain the proper balance, the air indoors is usually deficient in moisture, is dust-laden, lacks circulation, and is either too high or too low in temperature. Let us consider these in the order named.

The effects of lack of moisture may be observed in the way tobacco dries out and loses its freshness unless kept in a sealed humidor. This same drying process takes place in furniture and woodwork and causes the pages of fine books to become yellow and brittle.

Showing a typical Electrol Air-Conditioning Installation. The Direct Fired Unit

A more serious objection is its effect on the respiratory tract. We experience discomfort in the nose and throat because the dry air parches the delicate membranous linings, making all members of the household susceptible to the common cold and other more serious illnesses.

From a health angle alone, its importance cannot be overestimated. Just as the addition of moisture in winter is important to health, so is the removal of excess moisture in summer important to comfort.

The cleaning of the air is equally important. It includes the removal of pollen and other matters in suspension in the air that produce allergic disturbances usually collected under the term "hay fever."

The ability to rest for eight to ten hours, to sleep in an atmosphere free of such irritants, enables the most susceptible person to go about his work or his pleasure for the balance of the day in reasonable comfort.

The filtering of the air that removes the pollen also removes the germs and dust, and a new standard of cleanliness results in all directions.

The circulation of the air that distributes moisture in winter adds to comfort in summer by evaporating moisture for our bodies. Uneven temperature in the house is not only uncomfortable but is also a menace to health.

CONTROL OF THE AIR IN THE HOME

Modern improvements can automatically control all these important phases of air conditioning, but because temperature control is the primary essential of air conditioning it is described first and in greatest detail.

For complete control of temperature, automatic equipment for heating in winter is usually required, but cooling of dwellings in summer in many parts of this country is not absolutely necessary, because there are only comparatively few days when the temperature is excessive. Circulation of the air, the ability to maintain cooler night temperatures within the dwelling, and insulation against heat absorption during the day usually suffice.

By far the more important is control of winter temperatures—heating.

Controlled automatic heating can truthfully be said to be the primary step in air conditioning the home. To control the heating of a home properly, even temperatures within should be maintained at all times. This is only possible when a liquid fuel is used. Some fuels, of course, are more economical and safer than others.

The Complete Heating Unit Boiler, Burner, Hot-Water Heater

WHY OIL HEATING HAS BECOME SO POPULAR

Of the fuels which are used for automatic controlled heating, oil has found the most widespread acceptance. The reason for this popular approval lies: first, in the fact that oil is a fluid that lends itself readily to automatic control; second, it is economical in use; third, it is safe. Insurance underwriters have long recognized the safety and dependability of automatic oil heating and approve its use.

The inspection service provided for labeled equipment by the Underwriters Laboratories and the seal of the Oil Burner Institute—O.B.I.—are the homeowner's assurances of safety and dependability.

The use of oil as a fuel, in addition to providing automatically controlled temperature, relieves today's homeowner of distasteful tasks formerly associated with heating the home. When used with efficient equipment, oil burns with a clean, odorless flame, leaving no ashes to sift through the house or become ground into expensive floor coverings.

Automatic oil heating is now providing clean and economical warmth in well over a million homes throughout the country. It is bringing to these homeowners, many of modest income, comforts and conveniences and a leisure unknown several years ago to all but those of considerable means. Now the benefits of automatic oil heating are within the reach of all.

THE AUTOMATIC OIL HEATING UNIT FOR THE MODERN HOME

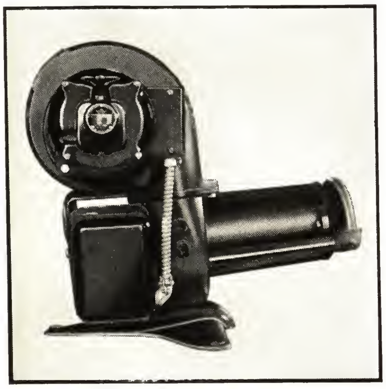
All the heating requirements for those designing a "House of Health" are found in the modern automatic oil-fired unit.

Essentially, these units consist of either a steam or hot-water boiler or a blower-type warm-air furnace combined with an automatic oil burner to form a unified and coordinated plant. Although it is of the utmost importance that the boiler or furnace be designed to capture and utilize the greatest number of heat units as they are released from the oil, the heart of the plant lies in the firing mechanism—the oil burner. It is on this vital part that satisfaction and economy largely depend.

There are different types of oil burners on the market today. Each employs its own method of preparing fuel for combustion. However, no burner is worthy of the homeowner's consideration unless it can heat his home with dependability and efficiency.

For dependable and efficient performance a rigid adherence to the basic laws controlling the combustion of oil is absolutely necessary. These laws, four in number, are:

1. The oil must be atomized or broken into very small particles.
2. The resultant oil mist must be correctly mixed with the proper amount of air.
3. The air-and-oil mixture must be burned in complete suspension.
4. Combustion must take place in the presence of a refractory surface to maintain combustion temperature.



Electrol Model TCV Burner

It is by preparing and burning oil in strict accordance with these principles that the Electrol Burner has demonstrated for many years, in nearly 100,000 homes, its ability to provide unusual dependability and economy.

THE ELECTROL AUTOMATIC OIL BURNER

The Electrol "Ball Flame"

The method of burning oil employed in this burner has proved itself superior to any yet devised, and, although conceived more than eighteen years ago, it has never been improved upon. This burner now embodies every development of modern engineering science and yet is the original basic mechanical design.

This greater efficiency is natural, because the design was developed originally to meet the severe requirements of providing heat in the operation of a steam automobile. Designed to perform efficiently for this purpose, the Electrol Oil Burner has a comparatively easy task when applied to a domestic boiler or furnace.

The fire in this burner is known as the "Ball Flame." A brief examination of the Electrol method of burning oil will show how this ball-shaped flame is produced and why it is an outstanding advantage.

The fuel is drawn from the oil tank by a motor-driven, self-lubricating pump and is forced, under pressure, through a small orifice in a scientifically grooved nozzle. As the oil leaves the nozzle it is atomized much the same way as perfume is broken into a mist by an atomizer.

A spirally rotating current of air picks up the oil leaving the nozzle at an angle and thoroughly mixes with this foglike spray. This oil-and-air mixture then is ignited by a continuous electric spark, producing a short ball-like flame held in complete suspension. This action occurs in the combustion chamber, built of refractory brick, in the boiler or furnace. When oil is prepared and ignited in this way, combustion is complete—every particle of heat is extracted from the fuel, and only the clean, smokeless products of combustion are passed slowly over the heat-absorbing surfaces of the boiler or furnace.

The Ball Flame is exclusively an Electrol achievement. The atomized oil, kept in complete suspension until consumed within the combustion chamber, does not impinge on the cooler boiler surfaces to form soot nor does it chill the burning mixture and permit fine particles of unburned oil to pass to the atmosphere by way of the chimney.

THE ELECTROL MASTER CONTROL

The operation of the burner is protected by an exclusive Electrol device called the "Master Control," whose special features are different from controls of any other design used for this purpose.

The important differences are that the Master Control:

(a) Is an integral part of the burner—set, tested and adjusted at the factory. It is not subject to the whims of an installer as to its location and adjustment.

(b) It is located out of the high heat zone—not in the smoke pipe or combustion chamber—and so it does not deteriorate rapidly.

(c) It is not, at any point, in contact with the products of combustion. It cannot become inoperative from deposits of soot, carbon or ashes as all other designs do.

(d) It is operated by clean air from the blower, heated to a moderate degree in the Thermo-Loop.

Although sturdy in construction, it is extremely sensitive and acts rapidly, should the existence of any abnormal condition make operation of the burner inadvisable. It provides an absolute safeguard against irregularities, such as:

Retarded fuel delivery through line or strainer stoppage.
Defects in electrical wiring or failure of ignition.
Operation of burner when fuel tank is empty.
Presence of water in the oil.

While any such conditions may seldom arise, yet the incorporation of the Master Control is the homeowner's assurance that his burner will operate safely and dependably.

A COMPLETE AUTOMATIC HEATING UNIT BOILER, BURNER AND HOT-WATER HEATER

Should you desire that your "House of Health" be heated by a steam, vapor-vacuum or hot-water system, Electrol offers the complete heating unit. The most recent accomplishment of experienced heating engineers, the Electrol-American Heating Unit will provide complete heating service in its cleanest, most dependable, and least expensive form. The unit is built in six sizes, the largest of which will heat a house of far more than average size.

The boiler of this unit is constructed of cast-iron sections and has been designed especially by the American Radiator Company engineers for high efficiency with oil-firing. The unit is shipped unassembled, and the sections are easily carried through the basement door and bolted together on the job.

The sections are scientifically designed for maximum heat absorption with extralong flue passages, increasing the area of heat transfer. The specially designed combustion chamber promotes quick and economical heating.

ECONOMICAL OPERATION

The unit is fired by the famous Electrol Burner especially designed for use in such combinations, and because of complete unity, with all parts properly balanced, remarkably high efficiencies are attained. The burner mechanism consumes the less expensive oil fuels.

An Electrol-American Heating Unit Installation, Showing the Hot-Water Storage Tank

ABSOLUTELY AUTOMATIC AND FULLY CONTROLLED

The unit is operated by a thermostat located in the living quarters of the house.

When this thermostat calls for heat, the oil burner in the unit is immediately set in operation. Later, when the air in the house has reached the desired temperature, the burner is shut down. This automatic action eliminates the wasting of fuel and insures even heat at all times.

The control devices of the Electrol-American Unit include a plain room thermostat of special design, the Electrol Master Control, and—on steam or vapor boilers—a pressure-limit switch, low water cut-off and safety valve. On hot-water boilers, in addition to a temperature-limit switch, a circulator may be used to provide positive control of the flow of hot water throughout the system.

QUICK, ECONOMICAL DOMESTIC HOT WATER

A Biltin Taco Water Heater of forty gallons capacity (larger sizes can be supplied) for the indirect heating of domestic hot water is mounted in the boiler at the rear. The coil is immersed in the hot boiler water to utilize its heat and provide quick, economical domestic hot water automatically throughout the year—winter and summer. No extra fuel tank is required, and no separate water heater is necessary. An aquastat controls the temperature of the domestic hot water, and in the summer no heat is passed upward into the house.

COMPACT AND BEAUTIFULLY JACKETED

An extended steel jacket of handsome though simple design completely encloses the burner, smoke hood, water heater, and controls. It is heavily insulated with indestructible asbestocel to prevent heat loss and insure quiet operation. The jacket is finished in beige baked enamel that will be in perfect harmony with any color scheme and will enhance the appearance of any basement. Conveniently located doors permit easy access to every part of the boiler or burner mechanism. The unit is extremely compact, being less than four and one half feet in height.

THE AIR-CONDITIONING SYSTEMS OF TODAY

Your "House of Health", to be truly modern, should be planned so that the benefits and comforts of air conditioning may be enjoyed in fullest measure. For the house of today there are two different systems by means of which the air may be so processed as to provide those conditions which modern living demands.

Both have their advantages, and it may be said that the installation you make will depend largely upon your own preference.

Electrol manufactures units for both systems. In the first type, an automatic boiler burner unit supplies the heat for the home. The upper floors, the bathrooms and the kitchen are heated with radiators. The other rooms are heated with conditioned air by means of a conditioner called a Split-System.

A Split-System installation performs all the functions of complete air conditioning, including the advantage of supplying all the domestic hot water needed—the year round. The conditioner may be used with the Electrol-American Unit or in conjunction with any other automatically controlled steam or hot-water heating equipment.

The unit is installed in the basement and is directly connected to the heating equipment. Duct work carries the conditioned air to the rooms where it is needed.

Operation of the heating plant and conditioner is automatically controlled by a thermostat located in the living quarters. When this control signals for heat, the heating plant is set in operation, but not until the heating coils have reached the proper temperature does the oversized blower unit start to circulate the air. Cold air is drawn from the rooms and passes through an air filterer which removes dust and impurities. This filtered air is then passed over the heating coil and humidifier, where it is mixed with the proper amount of moisture. The amount of moisture injected into the air may be controlled by a humidstat. Under these conditions, no attention on the part of the owner is required to maintain the desired humidity and temperature. The proper balance of temperature and humidity, so essential to your health and comfort, is automatically maintained. Finally, the conditioned air flows through the ducts and enters the various rooms at the registers.

Positive low-velocity air insures freedom from drafts, and proper humidification affords comfort at lower temperatures. There are no blasts of hot, dry air associated with the outdated gravity warm-air system.

In the second type of air conditioning no radiators are used. The entire house is equipped with the necessary duct work, registers and grilles, so that all rooms are air conditioned. The conditioning unit is called a Direct Fired Air Conditioner.

THE DIRECT FIRED AIR CONDITIONER

For those who prefer to run duct work for the conditioning of the entire house, Electrol offers the Direct Fired Air Conditioner. This unit is entirely self-contained. The blower unit, filters, humidifier and Electrol Model TCV Oil Burner are completely encased in a single steel jacket.

Heat exchangers are oversized and located so that large volumes of air are heated at low velocity. This method insures freedom from "hot spots" and drafts and, in conjunction with a properly designed duct system, makes possible a well-balanced air-conditioning plant.

Like the Split-System Conditioner, the Direct Fired Unit is fully automatic. It is built to:

Heat the air and automatically maintain the temperature for which it is set.
Thoroughly cleanse the air by means of an efficient renewable filter.
Circulate the air by means of a motor-operated blower.
Humidify by means of an enclosed humidifier.

FOR SUMMER COOLING

Both units are provided with means for adding refrigerating equipment should climatic conditions necessitate. In most cases, however, no equipment for summer cooling and dehumidification need be added. By making use of the blower unit during the summer, clean, dust-free air may be circulated evenly and without drafts throughout the house. This removes the hot blanket of air near the ceilings and permits more rapid evaporation of body moisture, producing a sensation of coolness and relieving discomfort.

THE UNIT ROOM COOLER

In cases where only summer air-conditioning is desired, self-contained units can be provided for cooling, dehumidifying, filtering and circulating the air in a room. For these units it is necessary to make provision for water piping in addition to the electrical circuits. The entire mechanism is enclosed in a handsome cabinet and is compact.

SELECTING THE EQUIPMENT FOR YOUR HOME

Modern living is so largely dependent upon household equipment that none but the best should be used. No consideration is of greater importance to the prospective purchaser of automatic-heating and air-conditioning equipment than its ability to operate efficiently and trouble-free over a long period of years.

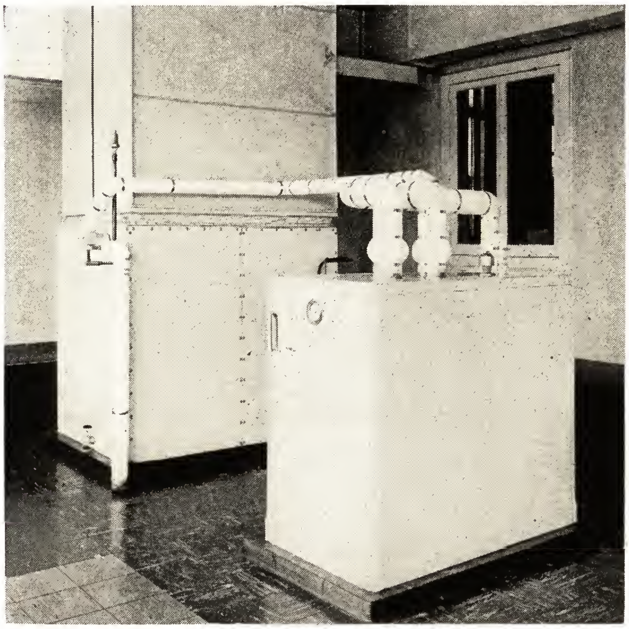
Electrol, as one of the oldest manufacturers in the industry, has built into its products the experience of nearly twenty years. The organization was established in 1918 and has been a leader in the quality field ever since. This company, soundly financed and properly managed, is in business to stay.

The first Electrol Burner was designed and manufactured by engineers who were pioneers in the industry. Yet after many years of extensive research and investigation, the methods of combustion and control embodied in this burner have never been equalled.

Unique engineering design has resulted in a burner unsurpassed for efficiency. Improvements to parts without change of design have been made continuously, and every improvement has been so designed that it will fit any of the existing models. Thus the purchaser is assured of lifelong dependability and a burner that cannot become obsolete.

To insure the most satisfactory performance, proper installation is as important as the equipment itself. For this reason every Electrol dealer is a heating expert, intimately acquainted with every phase of oil heating, capable of analyzing your heating problems and aiding in the selection of equipment that will meet your every need.

Before building your "House of Health" consult the author. He will be glad to refer you to the dealer in your vicinity who will show you the Electrol product that will fit your specifications, regardless of how unusual they may be. Discuss your heating and air-conditioning problems with the dealer in the assurance that his expert judgment is based on years of experience. You can rely on what he tells you and will obligate yourself in no way whatever.



Installation of the Electrol Split-System Air Conditioner

STRUCTURAL INSULATION Makes the Home Comfortable, Healthful and Economical

● YOU WANT your home to be insulated—to be comfortable, healthful and economical to operate. Ordinary homes with uninsulated walls afford little protection against the passage of heat. During the hot summer months the stifling sunrays beat through the roof and side walls, making the living and sleeping rooms uncomfortable; and throughout the long winter months valuable furnace heat seeps outside—increasing yearly fuel costs. All these conditions can be easily eliminated when you build your home. And they can be enjoyed without extra cost because rigid cane fiber insulation board takes the place of ordinary building materials.

In modern building construction rigid insulation is used on both sides of the framework—on the outside as insulating sheathing and on the inside as insulating lath. As sheathing it provides stronger, tighter walls that permanently insulate—eliminating wind infiltration, drafts and building distortion; and as insulating lath on all walls and ceilings it affords plaster protection, heat insulation, and quiets the passage of sound. This type of construction permits valuable breathing space between each stud.

WHAT RIGID INSULATION IS

Cane fiber insulation board is a structural insulation made from bagasse, the vegetable fiber waste of sugar cane after the sugar has been extracted. This fiber, in addition to its economic position and its practically limitless supply, is ideal for the fabrication of structural insulation board because the individual fibers are long, tough and strong; and, even untreated, their normal resistance to deterioration assures extraordinary durability.

During the process of manufacture the cane fibers are cooked and chemically treated (waterproofed) so that the entire board throughout its thickness is high water resistant.

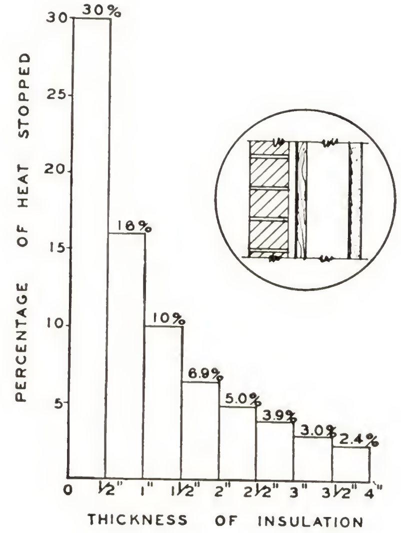
In order to meet various requirements, Celotex cane fiber products are manufactured in thicknesses ranging from ¼″ to 4″, in sizes up to 8′ by 16′, and densities ranging from 8.45 to 25 lbs. per cubic foot.

INSULATING VALUE

The thermal conductivity of Rigid Cane Fiber Insulation has been established by many nationally known laboratories (U. S. Bureau of Standards, Armour Institute of Technology, and others), the average conductivity being 0.33 Btu per hour, per square foot, per degree Fahrenheit difference in temperature per inch thickness.

THE PRINCIPLE OF DIMINISHING RETURN IN INSULATION

Insulating materials are governed by the law of diminishing return, which means that the first layer is the most effective in reducing the passage of heat in either direction through a wall or roof structure, and that each successive layer of insulation is less efficient than the preceding layer of the same thickness. For this reason, from 1″ to 2″ of insulation is usually sufficient for the average wall or roof structure.



The accompanying chart illustrates this principle and shows graphically the successive insulation values of eight ½″ layers of insulation, a total thickness of four inches. Note that in this case the first inch of insulation "stops" 46% of the heat passing through the insulated areas; and the first one and one-half inch, 56%. The remaining two and one-half inches of the total thickness of four inches "stops" only 21.2% more than the first one and one-half inch. It is apparent, therefore, that the first inch or inch and one-half of insulation is by far the most effective.

These percentages are based on data published in the ASHVE Guide and are for a brick veneer frame wall. Although the percentages would be slightly different with other types of walls, the general principle of diminishing return on succeeding layers would hold true.

FEROX PROCESS

All Celotex Cane Fiber Products are manufactured under the exclusive Ferox Process (patented) and therefore effectively resist damage by Dry Rot, Fungus Growth and Termites (White Ants).

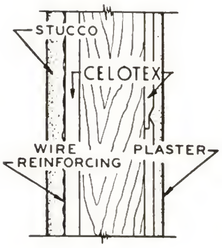
CELOTEX SHEATHING THAT IS INSULATING

In the new type of Vaporseal Insulating Sheathing the homeowner will find genuine cane fiber board in a new form, developed specially to solve the problem of moisture penetration and condensation. Note these important advantages.

1. It gives triple protection against moisture and deterioration.
2. Original fiberboard insulating value is maintained because the seal is on the surface.
3. Stronger and stiffer—provides far greater bracing strength.
4. Has the same thickness—25/32″—as the wood sheathing it replaces.

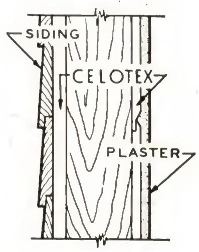
Coefficients of Heat Transmission with Rigid Board Insulation

U=0.17



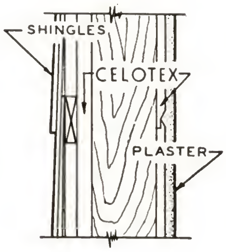
Stucco 1"
Sheathing 25/32"
Lath ½"
Plaster ½"

U=0.12



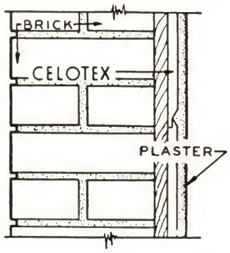
Wood Siding
Sheathing 25/32"
Lath 1"
Plaster ½"

U=0.13



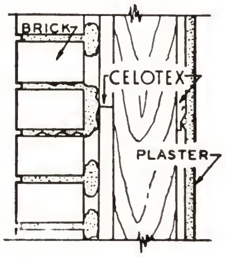
Shingles
Furring Strips 1" × 2"
Sheathing 25/32"
Lath ½"
Plaster ½"

U=0.16



Brick 8"
Furring Strips ⅝"
Lath 1"
Plaster ½"

U=0.16



Brick Veneer
Space ⅝"
Sheathing 25/32"
Lath ½"
Plaster ½"

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5. Marked for nailing—goes as fast—fits tight and stops wind infiltration.
6. Protected against destruction by termites and dry rot by the Ferox Process (patented).
7. Backed by the Celotex written guarantee for the life of the building.

Vaporseal is standard, time-proved Celotex sealed against moisture by a continuous surface coating of special asphalt on both sides and all edges

One side is additionally treated with a bright aluminum compound as a vapor seal. And because the seal is on the surface—not integral—full insulating value is maintained

INSULATING LATH

The insulating lath made by the Celotex Corporation provides a better plaster base **that insulates.** When applied on walls and ceilings it provides a continuous surface that reduces plaster cracking to a minimum.

This insulating lath has shiplapped joints; each lath is securely locked in place, providing a continuous surface with no holes to allow drafts. It can be sawed to fit tightly at corners and edges and bent around arches wherever necessary. Plaster cannot be pushed through to drop between the walls and create unnecessary dampness inside the framework.

Where this type of lath is used, redecorating costs are reduced because heat and dampness cannot leak through the walls and ceilings to cause dirty streaks.

The plaster knits firmly into the fibers of Celotex Insulating Lath, and the beveled edges provide a firmer bond. Tests have proved that the bond between lath and plaster will withstand a pulling power of over 800 lbs. per square foot.

A GUARANTEED INSULATION

When you build with Celotex you build with the assurance that the insulation is permanent. Celotex Cane Fibre Insulating Board is guaranteed in writing for the life of the building, covering the following ten vital points:

1. It is Guaranteed to Maintain Insulating Efficiency for the Life of the Building.
2. . . .Guaranteed to Provide Structural Strength.
3. . . .Guaranteed Not to Settle Away from the Framework.
4. . . .Guaranteed to Give Lasting Fuel Economy.
5. . . .Guaranteed against Destruction by Termites.
6. . . .Guaranteed against Destruction by Dry Rot.
7. . . .Guaranteed to Reduce Noise.
8. . . .Guaranteed against Loss of Insulation Efficiency upon Painting or Plastering.
9. . . .Guaranteed to be Water Repellent.
10. . . .Guaranteed to Meet Department of Commerce Commercial Standards and U.S. Federal Specifications.

ASPHALT and ASBESTOS ROOFING SHINGLES — What You Should Know About Them

● WHAT SORT of a roof shall I buy? Whether you are going to build a cottage or a mansion—regardless of size—eventually you'll have to decide that important question. Naturally, for your "House of Health" you will want a modern, fireproof, weatherproof and durable roof. It must withstand the constant and relentless attack of the elements—a sturdy watchman perpetually on the job!

A roof can either "make" or "break" a house. Since it is architecturally the most prominent part of your home, color plays an important part. It should be architecturally correct, blending in perfectly with its surroundings while reflecting your individual taste.

You can be assured of all these advantages—and more —if you get a Ruberoid Asphalt Shingle or Eternit Asbestos—Cement Shingle roof. Thousands of satisfied homeowners the world over can attest to this—time has more than proved it.

QUALITY DIFFERENCES ARE OFTEN HIDDEN

You can't tell much about the quality of a roofing shingle by just looking at it. There are hundreds of brands of asphalt shingles and prepared roofings on the market. They all look, feel and smell very much alike. They vary somewhat in price—and they vary greatly in quality. In spite of the opinions to the contrary, there are no rapid or superficial tests which will enable you to determine their relative durability. The only real test for asphalt shingles is on the roof.

It is, therefore, essential that before you build you know something of the various materials used in the manufacture of these prepared asphalt shingles.

Asphalt shingles are semirigid, highly colorful and extremely durable. They are very easy to apply and cost less than Asbestos Cement Shingles. Asbestos Cement Shingles, higher in price, are as rigid as stone. They are absolutely fireproof, practically indestructible, and their soft, rich coloring will last the life of the shingle.

WHAT ASPHALT SHINGLES ARE MADE OF

Asphalt shingles are made of four main components—felt, the fabric which forms their backbone or foundation; saturant, which penetrates the felt and forms a protective casing around each fiber; coating, which seals in the saturant, preventing its evaporation and excluding moisture, which would rot the felt; and the fire-resisting and colorful mineral surfacing, composed of mineral granules firmly embedded in the upper coating, which provides additional protection against the weather.

This charming home is protected by the Eternit Asbestos Cement Timbertex Shingle textured like natural cypress.

HOW THEY ARE MADE

The base is a heavy and thick felt, a body structure of the strongest known fibers of wool and wiry cotton and tough burlap.

Then, this is thoroughly saturated with enduring bitumens—so that every fiber is coated and welded together.

To this great foundation is added a heavy under layer of asphalt and the two are permanently bound together by great heat and pressure.

Then to the upper surface of this already compound shingle is added still another thick, impenetrable layer of asphalt with the power of withstanding every change of temperature—of warding off the searching fingers of wind and rain and ice and snow.

Finally, a surfacing of mineral particles is firmly pressed down into this tenacious weather-resisting upper surface, so deeply imbedded that it becomes an integral part of the shingle, and so rich in color that Genuine Ruberoid Shingles become an enduring ornament.

MANY STYLES AND COLORS

These shingles are made in a variety of distinctive styles and attractive colorings. There is a shape and style to suit each individual taste and to harmonize with the architecture of the buildings on which they are to be applied. The Massive Unit, for instance, generally acknowledged to be the finest of asphalt shingles, provides triple coverage over the entire roof and deep interesting shadows cast by its heavy butts. The ever-popular Hexagonal Shingle, which is available in four different weights and sizes, is ideally suited for any home and any size pocketbook.

The colors of the shingles are scientifically developed and harmoniously blended. The wide range available enables you to select a color combination that will be distinctly different from your neighbors'.

THE FIRST COST IS THE LAST

Genuine Ruberoid asphalt shingles provide your "House of Health" with weather protection that is not only complete and satisfactory in every way—but a weather protection which is truly lasting. The Ruberoid Company pioneered the development of Asphalt Roofing Products and for forty years Ruberoid engineers have been constantly alert to maintain the high quality of Ruberoid Building Products and to improve it wherever possible.

THE ASBESTOS SHINGLE IS THE IDEAL ROOFING SHINGLE

Although a far more recent development than the asphalt shingles, the same painstaking research and experimentation have gone into the manufacture of Eternit Asbestos-Cement Shingles. Because of their many distinctive advantages—such as fireproofness, beautiful textures, high insulating value, and durability—Eternit Asbestos-Cement Shingles represent the ideal roofing shingle. They are achievements of artistic as well as mechanical merit.

HOW THEY ARE MADE

Eternits are made of two rocklike fireproof materials—Portland cement, reinforced with carefully selected asbestos fibers. These materials are combined by an ingenious building-up process which insures an even distribution of the reinforcing fibers throughout the finished shingle and, consequently, results in remarkable strength and resiliency.

The shingles are finally subjected to tremendous hydraulic pressure, giving them a great density, so that they are waterproof as well as fireproof and practically impervious to the effects of time and the elements. Eternits are truly an ageless product, as the name implies.

COLOR IS INTEGRAL PART OF SHINGLE

Eternits are extremely attractive in appearance. They are made in a variety of beautiful colors which are produced by the use of pure mineral oxides mixed right in with the mass of cement and asbestos fiber. Thus, the color is an integral part of the finished shingle and is lasting in quality as well as beautiful in appearance. Finally, Eternits are given a special chemical treatment to fix the colors and to break down any chemical elements in the shingle itself which might eventually affect its appearance.

ETERNITS ARE HIGHLY ADAPTABLE

Eternits are furnished in several different styles and sizes. Each is adaptable to some particular architectural or economic condition, so that there is an Eternit shingle suitable for every building where shingles of any type can be used.

THE GOTHIC

Textures of unusual softness and beauty further enhance the architectural adaptability of Eternits. You will find age-old architectural charm in the rugged rocklike texture and the soft mellow charm of the Eternit Gothic. Made also in random widths and designed so that it can be applied with staggered butts, the Gothic offers unusual opportunities for individuality in roof design, both from the standpoint of roof line and color blending.

THE TIMBERTEX

The newly created Timbertex Tapered American Method Shingle is perhaps one of the most popular of its kind. It has a beautifully textured surface that reproduces faithfully the fine graining of weather-aged cypress. Because they are tapered, they lie perfectly snug and tight on the roof, giving maximum protection against the weather.

GOTHIC ASBESTOS-CEMENT SHINGLES

MASSIVE SQUARE-TAB ASPHALT SHINGLES

ASBESTOS CEMENT SIDING—The New Modern Wall Covering

The idea of using a permanent sidewall material which does away with maintenance costs should appeal to you, as it has to thousands of homeowners and home builders the country over, who have chosen Eternit Timbertex Asbestos-Cement Sidings for their homes.

LOW UPKEEP

Designed especially to eliminate periodic paint bills and other upkeep costs, these rigid, indestructible "wood-textured" shingles represent the ideal siding.

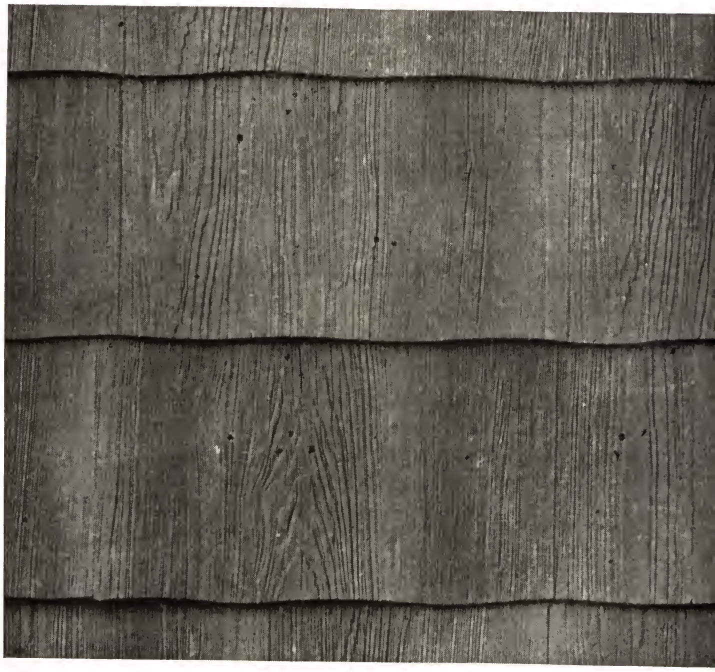
Made of the finest grade of Portland cement and asbestos fibers, they are absolutely fireproof and will give your home lifetime weather and fire protection.

Applied like ordinary wood shingles, they are simply nailed over the rough board sheathing over which has first been laid Ruberoid Weatherpad—a remarkable insulating paper. The soft, rich cypresslike texture of these Timbertex Sidings will add years of architectural beauty and charm to any home on which they are applied.

MANY DIFFERENT TYPES

Eternit Timbertex Sidings are available in a number of different styles and "woodlike" colors. The mineral oxide colors are mixed right in with the asbestos and cement and are thus made an integral part of the shingles themselves. They may be applied in a combination of colors and styles, depending, of course, upon the architecture of your home and your personal preferences. Colonial Timbertex Siding and Thatch Timbertex Siding, illustrated below, have proved to be two of the most popular styles, and rightly so, since the Colonial and Thatch designs lend themselves to most residences. Eternit Asbestos Siding is also available in a design which exactly reproduces the effect of wire-cut brick.

Eternit Timbertex (Asbestos-Cement) Siding applied on a residence



Colonial Timbertex Asbestos-Cement Siding

The "HOUSE OF HEALTH" Is an Insulated House

Will there be rooms in your new home that are hard to heat properly in winter—cold, drafty and uncomfortable, no matter how much you drive your furnace? Will you have to pay more than you should for fuel?

In summer will you find the upper floors of your home unbearably hot—hotter even than the outdoor air? Will your bedrooms be so uncomfortable on hot nights that you cannot sleep?

Many of us have accepted these household discomforts as among those inevitable things that cannot be avoided, except at great expense. But the "House of Health" is a comfortable, healthful house, because *it is insulated against winter cold and summer heat.*

And, because the insulation is installed at the time the house is built, the cost is surprisingly low.

An uninsulated house "leaks" like a sieve. The old-type house was built with hollow walls—thin empty shells, which provided ineffective protection against outdoor tem-

peratures. On the inside was a layer of lath and plaster; on the outside sheathing covered with shingles, clapboards, brick or stucco. Only a thin ceiling of lath and plaster separated the bedrooms from the attic, and over this the roof—only a thin layer, watertight, but not heat-tight.

It has long been a popular impression that these hollow spaces were good insulation, because they were filled with "dead" air. This is far from true. It is not "dead" air but "live" air, continually circulating inside the walls and around the roof rafters and attic floor beams. It draws heat out through the walls and roof in winter, and brings outdoor heat into the home in summer. Comfort is lost; fuel wasted.

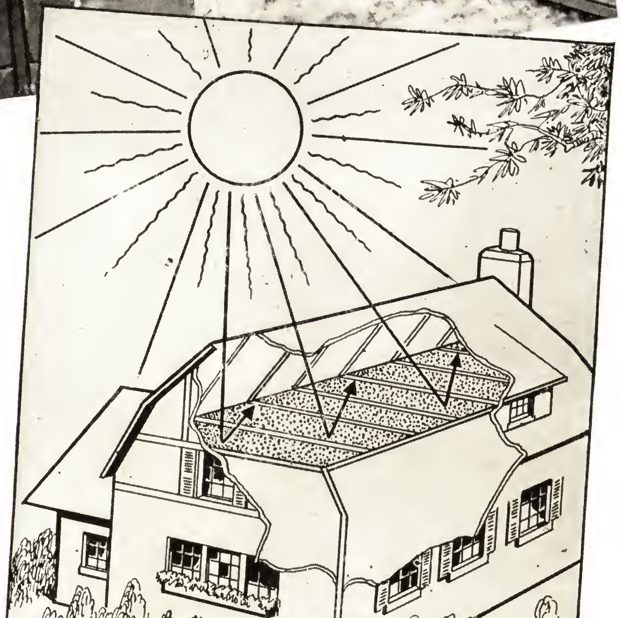
INSULATION REDUCES FUEL COSTS 15% TO 30%

The value of insulating a home, whether it is new or old, is today generally recognized. The outstanding advantages derived from a properly insulated building are substantial savings in fuel costs, increased summer comfort, elimination of drafts and a material increase in the resale value of the building.

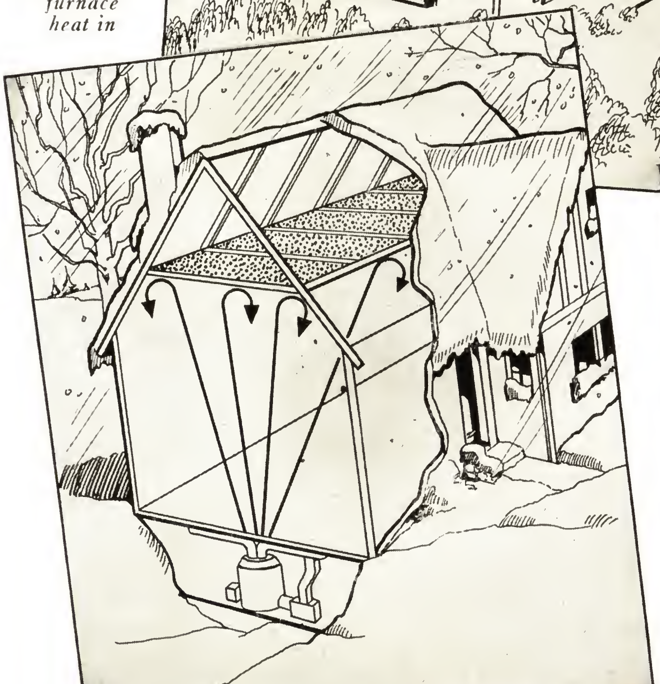
When selecting an insulating material, it is important that you get the best, because there are many insulating materials on the market today of varying degrees of efficiency. Ruberoid Rock Wool, in its recommended thickness of four inches, is the most efficient, practical and economical insulation. It will not deteriorate or decompose in use.

Ruberoid Rock Wool Insulation is in itself not only fireproof, but, when applied, it fills various spaces which, in case of fire, act as flues.

You can insulate your attic floor at modest cost. This is generally conceded to be the most practical and economical way to insulate a home since heat rises and a high percentage of the heat loss is through the roof. Likewise, in summer, the direct sunrays are against the roof area. Savings of 15% to 30% in fuel costs can be expected, and you will also find that your home is considerably cooler in summer.



Rock Wool keeps summer heat out



Rock Wool keeps furnace heat in

Rock-Wool House Insulation means a comfortable home, winter or summer

PLANNED WIRING To Make Your "HOUSE OF HEALTH" Comfortable and Convenient

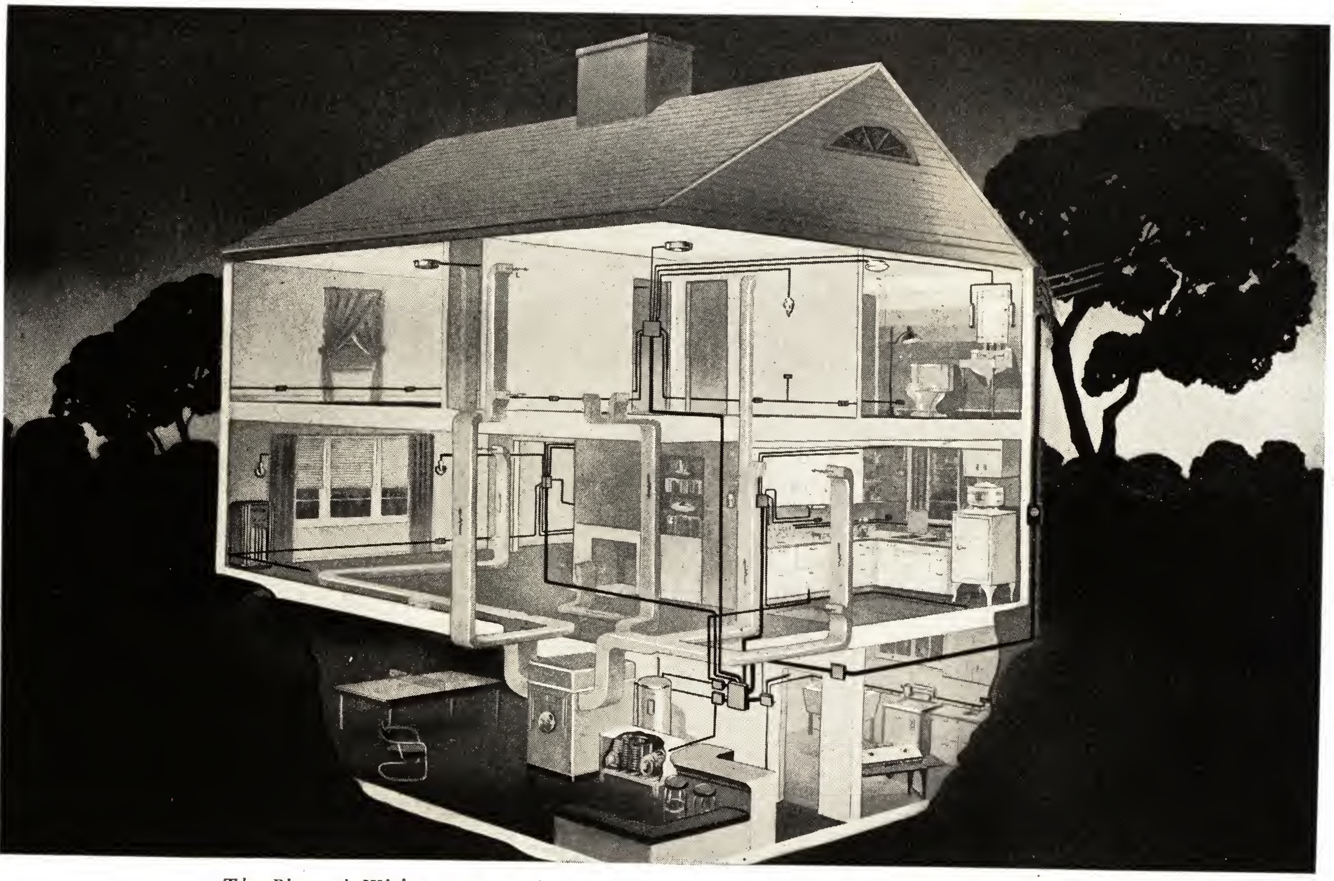
● TODAY, more than ever before, architects are planning, contractors are building, and people are buying *Houses of Health*. Perhaps most of them are not so aptly labeled. They may be called *Functional Houses, Modern Houses, New American Homes*—anything to indicate that they are comfortable and really livable. All of them, to a varying degree, include new materials and methods which furnish the owner or the tenant with more healthful surroundings. Relative to the great majority of existing residences, they are *Houses of Health*.

The architect, as he starts his planning, realizes, certainly, that his client demands more than a healthy place to live. There are other factors that are important in the success of the proposed home. Experience—sometimes costly—has taught the alert home buyer to examine closely the things that will make his home a better dwelling place.

Convenience, which can be expressed in so many ways, is a vital point. Homes, if they are to be up to date, must be adaptable to the living habits of modern, active families. Rooms must be laid out to save steps. Windows must be placed with regard to the elements. Heating and ventilating must be chosen with a thought to convenience—as well as to health.

In any discussion pertinent to the convenience of residential buildings, it is not long before electricity is mentioned. For, though some of the elements in comfortable living have progressed slowly, the utilization of electric current has advanced rapidly. Appliances for use in homes have been improved. New ones have been developed. The design, the manufacture, and the presentation of electrical labor-saving equipment have taken place steadily. The things that are asked of electricity are legion.

Your home is lighted—completely and healthfully—by electric current. Your food is cooked—often prepared—by electricity. Electricity enters your laundry to lift a burden from the housewife's shoulders. With it, homes are heated and ventilated properly. As time goes on, who can say



The Planned Wiring System offers home builders the utmost in healthy, happy living.

what other tasks will be delegated to this most willing servant?

Because you ask these things of electricity, it follows that your home should be well prepared for its delivery and utilization. This means that you should insist on a wiring system that has been designed with today's and tomorrow's needs in view. Unless you make this provision your home will be beset by problems that impair its usefulness, diminish its enjoyment. Lights will flicker and dim when electrical equipment is being used. Appliance efficiency will be lessened because the necessary amount of current is never delivered by an inadequate wiring system. Electricity, when it must travel through the meandering system common in existing homes, is wasted. It will take longer for your flatiron, toaster, or electric heater to do its job.

How are you going to make certain that your *House of Health* is electrically fit? How can you know that the wiring system that is installed will do all the things you ask of it—this year and in years to come? There is one way to answer this problem for all time. Insist that the *House of Health* in which you are interested incorporates G-E Planned Wiring . . . The Radial Wiring System. Thus, in a single order, you have provided for the comfort and convenience that will make your home a more enjoyable place in which to live.

Planned wiring, in a limited sense, is not new. But never, until this most recent plan was developed, was there a system so complete. General Electric engineers, cognizant of the electrical demands in a modern home, designed this system. They investigated the requirements of household appliances and electrical equipment and designed the Planned Wiring System as an efficient solution.

Convenience outlets for the utilization of electricity are the homeowners most important evidences of the wiring system. They should be placed so that appliances and lamps can be easily connected. There should be enough of them. If there are sufficient outlets it will never be necessary to disconnect one appliance in order to use another.

In the General Electric System of Planned Wiring you will find that there are convenience outlets for every need. Future additions of outlets—costly and bothersome—will be unnecessary.

The value and service of any convenience outlet is dependent upon the wires which serve it. Unless the distribution materials in the wiring system are of correct size and intelligently planned, there will be inefficiency and loss. Let us draw a corresponding example to make this statement more clear. Watering your garden with a tiny half-inch hose would be a tedious and wasteful task. The wires in your home carry electricity in much the same way that a rubber hose carries water. They must be large enough for the appliances at the end of them to receive enough electricity to make them work correctly.

In the G-E Planned Wiring System the size of every wire is correctly specified. From the meter to the lamps and appliances, you can be sure that the wires will deliver sufficient, economical current.

It is important, too, that the wires that carry the current through your *House of Health* be intelligently planned. The inadequately wired home was served by two or three long circuits that wandered through the whole house. Here, again, electricity was wasted. The General Electric system eliminates this by specifying a larger number of circuits with shorter runs. The number of circuits, of course, will depend on the size and construction of the home.

The protection of the circuits in residential buildings, heretofore, has been delegated to fuses, usually located in the basement. Homeowners often found this arrangement troublesome. Fuses were blown out. Replacement entailed a trip to the basement, difficulty in replacing the worn-out fuse, and a general upheaval in the serene course of living.

Now your *House of Health* can be protected by a new Branch-circuit Circuit Breaker. These General Electric devices are located near the circuit they control. Because they are neat—having the appearance of a tumbler switch—they can be placed in any room of the house. When a short circuit or an overload occurs, they flip to "off" position. When the trouble has been remedied, a simple movement of the tumbler brings the circuit back into use. There is no necessity for going to the basement or other inconvenient place.

Neat, accessible Branch-circuit Circuit Breakers protect and control electricity in the "House of Health."

The G-E Circuit Breakers control as well as protect the individual circuits. Thus, if you want to turn out all the lights on one circuit, you can easily flip the breaker to the "off" position and back to the "on" position when you want the service resumed.

The control of electricity in your home is another way in which the superiority of the Planned Wiring System is evident. G-E Flush Tumbler Switches are located at points where it is desirable to control electric current. In all rooms having more than one door, 3-way or 4-way switches are located at each door to control one major source of light in each room. They are also used to control lights in halls or passages, on different floors of a residence, between detached buildings, and wherever it is desirable to control light from separate entrances and exits.

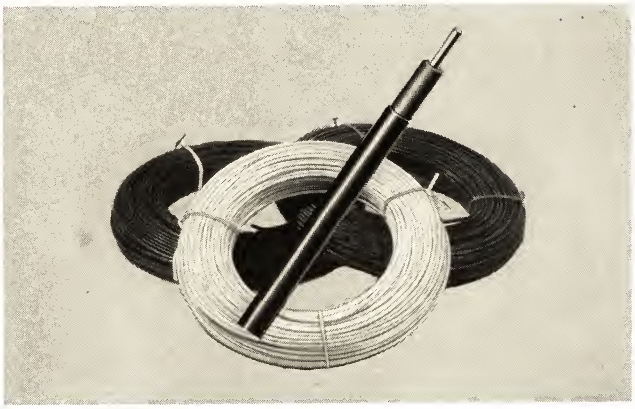
We have described, very generally, the G-E Planned Wiring System. Its advantages and superiority over most existing systems have been pointed out. Certain additional details will be indicated by your contractor or architect.

Truly, the Planned Wiring System should be incorporated in your *House of Health.* With its installation you benefit by the experience and judgment of engineers who understand residential wiring. By specifying it, you place the electrical wiring of your home in the hands of men who are competent to provide real electrical comfort and convenience.

The success and quality of the G-E Planned Wiring System is dependent—to a large extent—upon the quality of General Electric wiring materials. Upon the use of these materials the system was designed. From a single source your contractor can obtain all of the wiring materials that form the Planned Wiring System in your *House of Health.*

DISTRIBUTION MATERIALS

The first item to consider, in a discussion of wiring materials for residential wiring, is the material used within the house to carry the current. It is known variously as the conductors or building wires.

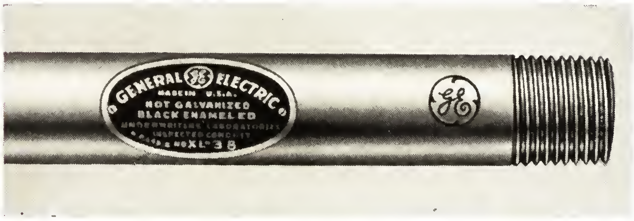


Building wire is an important starting point in the distribution of electricity in the "House of Health."

G-E Building Wire is insulated with high-grade, long-life insulation and is provided with moisture-resisting and flame-resisting covering for maximum protection. There are eight different-colored braids, so that your electrical contractor may easily identify the circuits. The braids are smooth and easy to pull through the protecting tubing. All of these features save you money, since the contractor can work more easily and quickly with these G-E Building Wires.

Having decided on the conductor to use, it is necessary to determine how to protect it. It must be protected from mechanical injuries which cause short circuits.

For stud-type buildings there are several types of protected cables available. BX Armored Cable consists of one or more standard code wires further protected by a Kraft paper wrap and a flexible interlocking-type steel armor over all. Oval BX Cable is similar in construction but differs in shape. There are also Lead Sheathed Armored Cable and BraidX Nonmetallic Sheathed Cable.

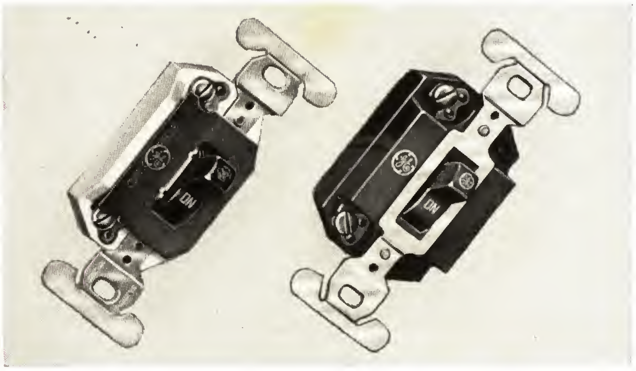


Wiring is ably protected by the G-E Rigid Conduit.

Electrical Rigid Conduit assures maximum protection. It is impervious to heat, moisture and acids, and completely protects wires from mechanical injuries. General Electric Rigid Conduit offers superior protection to your *House of Health.* A complete line of fittings and boxes for the entire installation is available.

THE SWITCH CONTROL OF THE PLANNED WIRING SYSTEM

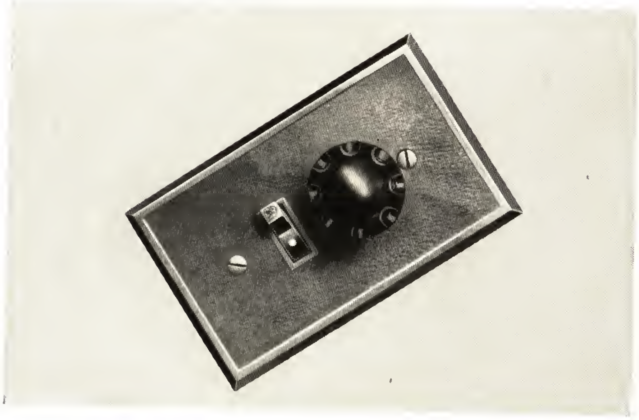
There is a General Electric Flush Tumbler Switch for every application in your *House of Health.* With the aid



The convenient control of electricity is dependent upon switches correctly located.

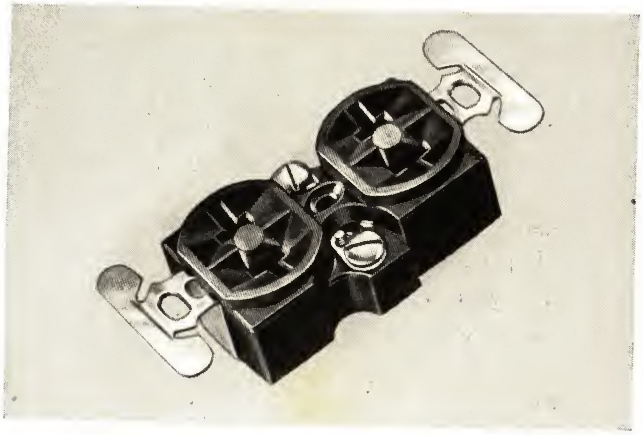
of your electrical contractor you can choose the ones that should be used in your home.

As well as the standard G-E switches, there are special and combination types which are adaptable to particular situations. The Flush Tumbler Mercury Break-Switch is completely silent. Such a switch is primarily used in locations where silence is essential, as in bedrooms or nurseries.



For basement, garage or attic, the Pilot Light Switch is a useful addition to your home.

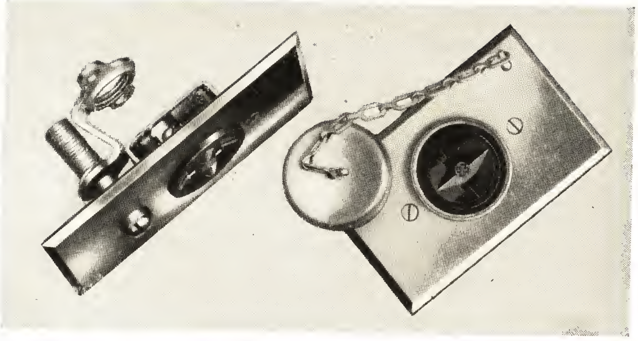
The Pilot Light Switch operates a small telltale light while the circuit is closed or the light "on." It goes out only when the switch is "off." Such a switch is commonly used to control the lights in basement, garage or attic. It will save money and steps for you.



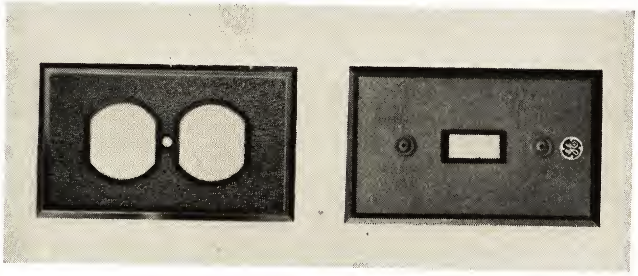
Utilize electricity fully with a sufficient number of convenience outlets.

Convenience outlets, so essential to comfortable and convenient living, are part of the complete General Electric line of wiring materials. Besides the standard twin-convenience outlet which you want in your *House of Health,* there are several special types that are especially adaptable to modern living.

For your electric wall clock there is a Flush Electric Wall-Clock Hanger and Outlet. The outlet is recessed to permit the slack cord to be taken up and concealed. A Fan Hanger Outlet is available, which provides the electrical connection for the fan and affords, as well, a support for the fan. There is a weatherproof outlet that can be used for outdoor installations, such as floodlighting, Christmas decorations, etc. Convenience outlets can also be obtained with pilot light, switch and outlet.



Special outlets for particular applications will readily prove their worth in comfortable living.



The attractiveness of the electrical system is insured with neat wall plates for switches and outlets.

The plates that conceal the mechanism of a convenience outlet or a switch can be obtained in a variety of shapes and materials. Brushed brass, brown textolite, or ivory plates will harmonize with the interior decoration of your home.

Necessarily, this discussion touches on only the most important parts of the line of wiring materials. As well as the products that are mentioned, General Electric offers your *House of Health* materials for the wiring of ranges, doorbells, radios—anything that is operated by electricity in a modern dwelling.

The wiring system for your *House of Health* has been discussed from every angle. First it was studied as a complete unit and then some of the particular items were described. You must have noticed how each part went toward forming the whole. The Planned Wiring System is engineered as a complete unit. Every item is designed to be used with another. As a result, you obtain a wiring system that is complete in every detail. And when your *House of Health* is ready, you can proudly announce that the wiring system in your home is manufactured and guaranteed by one company—General Electric.

The Twofold Purpose of LIGHT

● MODERN lighting in the home has a twofold purpose. The first is to give you eye-comfort illumination. The second is to decorate.

BETTER LIGHT—BETTER SIGHT

Consider first the all-important purpose of lighting in providing proper eye comfort and efficient illumination.

Scientists have recently discovered that lighting in eight out of ten homes today is entirely inadequate for good eyes and good sight. They have used as their measure of light the foot-candle, which is the intensity of illumination on a perpendicular screen one foot away from a "standard" candle. This unit is the measure of lighting intensity, as a degree is a measure of temperature.

For instance, the scientists explain that the intensity of light outdoors on a clear sunshiny day is 10,000 foot-candles; in the shade of a tree, 1,000 foot-candles. For hundreds and thousands of years man lived outdoors, and his eyes were developed to see naturally under these intensities. It has been only in the last several hundred years that man moved indoors, thus creating the demand for an artificial light source. It must be remembered that each succeeding generation of man's life indoors has demanded more and more critical work from the eye. However, in spite of man's ability to produce a very efficient substitute for natural sunlight, people in general have not given sufficient thought about its proper use for eyesight conservation. The average intensity of illumination in the home today is only about five foot-candles, which is only a fraction of the amount of illumination outdoors.

Little wonder then that eyestrain takes such a staggering toll today. One fourth of the young people today suffer from defective vision, three fourths of all people over fifty suffer from defective vision, and 95 per cent of all people over sixty have defective vision.

Eyestrain is one of the penalties that we pay for indoor life; and indoor life means not only close work with the eyes, but, most of all, it implies artificial lighting.

It is not artificial light itself that strains the eyes, but inadequate illumination. Artificial light can be made just as satisfactory for the eyes as daylight. But as found in most homes today, illumination is far from adequate.

HOW TO OBTAIN EYE-COMFORT ILLUMINATION

The prevalence of inadequate light has been responsible for the Better Light—Better Sight movements which are receiving nation-wide attention, especially in magazines devoted to making the home more comfortable and beautiful. As a result, entirely new standards for adequate home illumination have been established:

1. Have enough intensity for the seeing task to be done.
2. Avoid glare—shade all bulbs.
3. Avoid contrasts—have enough light in enough places.
4. Light should be placed so that there will be adequate light on the work without shadows, and so that a healthful and comfortable posture will be natural.

HAVE ENOUGH LIGHT FOR SEEING TASK TO BE DONE

As a general guide to how much light is needed, science has specified the following quantities of light as a minimum for certain kinds of work:

100 foot-candles or more—for very severe and prolonged tasks, such as fine needlework, fine penwork, sewing on dark goods, and discrimination of fine details of low contrast.

50 to 100 foot-candles—for severe and prolonged tasks, such as difficult reading, average sewing and other needlework.

20 to 50 foot-candles—for moderately critical and prolonged tasks, such as clerical work, ordinary reading, average sewing and other needlework on light goods.

10 to 20 foot-candles—for moderate and prolonged tasks of ordinary reading and sewing.
Under 10 foot-candles—unsuitable for critical visual tasks.

SEEK COMPETENT ADVICE

To be sure that your lighting intensity will be adequate, it is best to get the help and guidance of a home-lighting advisor from your electric-light company. The advisor will come into your home or check over your plans and help you work out the most practical, suitable and effective form of lighting. And later, with the Light Meter, you will be shown how every member of your family is getting the eyesight protection, the comfort, and the charming and cheerful surroundings that good style in lighting gives.

LIGHTING THE HOME ROOM BY ROOM

The modern trend in lighting the individual rooms of the home is mainly by means of the semi-indirect and totally indirect type of fixtures, built-in panel and cove lighting, and floor and table lamps. From the standpoint of both eyesight conservation and beauty, elimination of glare and harsh shadows, the softly diffused light from these types of lighting equipment provides complete eye comfort and adds to the decoration of the room.

It is important to note that semi-indirect and indirect lighting depend upon the ceilings and the walls for light reflections. So it is suggested that ceilings be painted a dull white, cream or ivory for best effects.

A BRIGHT, CHEERFUL ENTRYWAY

A welcome light outside the door is a hospitable greeting to the evening guests. This light should be so located that it floods the steps with illumination. Waterproof fixtures, singly or in pairs, can be used according to the style of architecture, but a modern method is to install built-in lighting. This lighting may be concealed behind a frosted-glass panel built into the porch roof or outside the doorway in such a way that the entrance is flooded and framed with light.

Good lighting at the entrance is a welcome greeting to guests. The charm of the exterior promises comfort and hospitality within.

LIGHTING THE HALL

The entering guest is welcomed with cheer or gloom, depending upon the hall light. In an average hall a lantern or shaded-candle type fixture is appropriate for a ceiling fixture. On a console table may be placed a lighted ornament or an interesting lamp. Or a pair of torchères flanking a table or a piece of tapestry will add a decorative touch. Here again the modern trend of panel and cove concealed lighting is becoming popular.

The upstairs hall must supply light for safety on the stairs, using an enclosed type of fixture giving a diffused light without glare. All lighting equipment in both halls should be controlled by separate switches upstairs and downstairs so that they may be turned on and off from either floor.

MAKING THE LIVING ROOM MORE LIVABLE

The living room is the most important room in the home. And from the standpoint of lighting for decoration and efficiency it provides the widest range for original ideas.

The most common method of lighting the living room is by means of ceiling fixtures, wall brackets, floor and table lamps, or the increasingly popular cove and built-in panel lighting. The modern ceiling fixture, if desired, may be obtained in a wide variety of designs of either the indirect or semi-indirect type. These fixtures are not only decorative in themselves but produce soft, glowing illumination which adds substantially to the color of the room decorations.

If wall brackets are desired, they should be considered for their decorative value only and not as a source of light when reading, working or entertaining. If installed, it is important to remember the lamp bulbs in wall brackets must by all means be shaded.

To meet the individual needs of every member of the family, plenty of floor and table lamps are needed in the living room. This lighting serves both the utilitarian purpose of providing proper light for work and reading and also the decorative purpose of bringing to the room a restful, cheerful and welcome atmosphere. The latest development in portable lamps is the new scientifically designed reflector type, particularly applicable for all close visual tasks, such as reading, writing, sewing and playing games. These lamps are known as the I E S Better-Sight Lamps, bearing the approval tag certifying they have met rigid specifications.

The living room is the most important room in the home. Modern scientifically designed fixtures and lamps make it attractive to look at and a comfortable place for the whole family to work, read and play.

With plenty of portable lamps, the ceiling fixture and wall brackets, or the more modern cove and panel lighting, the homemaker is able to light her living room for any occasion by making different lighting combinations.

LIGHT FOR SPARKLING CONVERSATION

While high intensity is not an important factor in dining-room lighting, it is essential that the room be bright and cheery. Nothing will add more to the enjoyment of a meal or the decoration of this room than ample, pleasing lighting. The silver, the snowy-white linens, the attractive chinaware, can all be made to take on an inviting gleam and sparkle by proper illumination. Recommended methods of lighting this room are by means of the new indirect lighting fixtures in a wide and pleasing variety of designs which throw a soft, shadowless light over the entire room. Wall brackets can be used if the light is properly shaded, but they should be used in conjunction with candles on the table. Or in place of wall brackets the modern cove lighting can be attractively employed.

What a charming setting for a dinner party. The soft harmonious lighting which makes the table setting sparkle, but keeps light out of the eyes, puts guests immediately at their ease.

The well lighted kitchen is an inspiration to the cook. Lights are right everywhere.

MODERN KITCHENS DEMAND MODERN LIGHTING

The kitchen is the workshop of the home. So it is vitally important that this room be made as cheery and comfortable as possible. Good lighting accomplishes this and helps to speed up kitchen tasks. The kitchen should have plenty of light everywhere. It should be so arranged that the worker, regardless of position, is never working in her own shadow. Recommended for modern kitchens is diffused lighting, coming either from an indirect or semi-indirect ceiling fixture or from concealed lighting in the walls of the room, supplemented with spot-light sources at work centers.

Built-in lighting in closets and over the sink and the range is growing in acceptance. For best kitchen-lighting effects the walls and ceilings should be painted or decorated in light colors.

It is important to have plenty of convenience outlets throughout the kitchen located near the top of the working counters for use of electrical appliances which are essential equipment in the modern household.

If there is a breakfast alcove, a semi-indirect or indirect type of ceiling fixture will be satisfactory, or it may be preferred to carry out concealed lighting similar to that in the kitchen.

LIGHTING THE BEDROOM

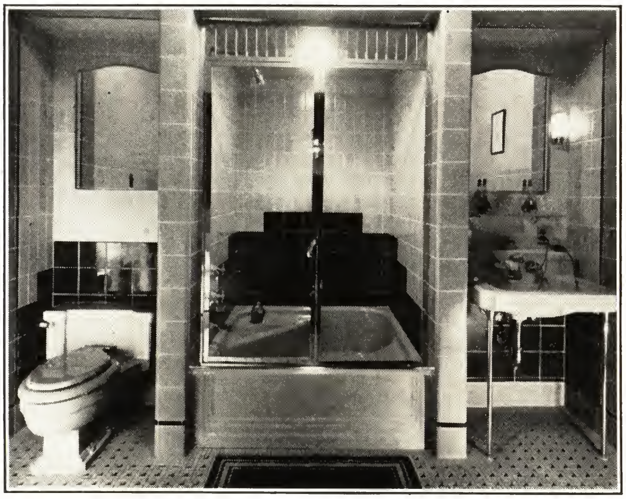
Every woman likes to change the arrangement of her furniture frequently, particularly in bedrooms. Too often, however, furniture arrangements are limited by the lighting fixtures, and this is especially true if the room is lighted only with wall brackets. Therefore, every bedroom should have a central ceiling fixture. There are many pleasing designs of fixtures of semi-indirect and indirect types which fit well into any bedroom. These are so designed as to throw a soft, diffused light throughout the room, avoiding harmful glare.

Good bedroom lighting for healthy relaxation is so important. And for dressing we need to see ourselves as we are to be seen —a bright glareless light for a satisfactory make-up.

For reading in bed new types of scientifically designed portable lamps for side tables are available and recommended. If tables are not available, the newly designed wall lamp known as the Pin-it-up Lamp is convenient and effective. The easy chair or chaise longue requires a floor or table type of scientifically designed lamp for comfort and close visual tasks. On the dressing table the placing of two so-called vanity lamps has been standard practice in the past, but the modern method is the installation of the new lumiline lamps, one on either side of the mirror, or one placed directly over the mirror. These lamps throw a diffused light but of adequate intensity for a satisfactory Milady's toilette.

LIGHTING THE BATHROOM

There is no room in the home where it is more essential to have lighting of high intensities than in the bathroom. Here the utilitarian value of the lighting should be considered far above the decorative quality. Recommended is a simple type of indirect or semi-indirect ceiling fixture or the more modern concealed panel lighting for general illumination. The mirror should be lighted by the new type lumiline lamps, one on each side, or by concealed panel lighting placed on both sides or at the top of the mirror.



All of us give more time to the beautifying process when the bathroom is bright and cheerful.

Growing in popularity is the installation of a sun or health lamp in a built-in reflector over the tub or shower bath. Or if that is not possible, a convenience outlet in the wall near the basin is desirable for the use of a sun lamp and other electrical appliances.

OTHER IMPORTANT LIGHTING

Sun Porch—A ceiling-type fixture is recommended rather than wall brackets. A number of convenience outlets are necessary for supplemental lighting by floor and table lamps for reading, sewing and decorative purposes, just as in the living room.

Basement—Ample light should be provided throughout the basement for every task which is performed there. Supplementing a general ceiling light there should be an individual light for the furnace and vegetable or fruit storage closet. A light so placed as to completely illuminate the basement stairs is highly desirable for safety. The laundry section requires a ceiling light for general purposes and plenty of convenience outlets for various laundry appliances. If there is a workbench for "him," by all means a good strong shaded light should be located in the ceiling over the bench.

Closets—All closets should be lighted. Nothing is more irritating than fumbling around in a dark closet. An automatic door switch operating an inside light as the door is opened and closed is the most satisfactory method.

Garage—Recommended is at least one enclosed-glass type ceiling fixture with an outside light over the doorway.

Garden Lighting—Floodlighting flowers and shrubbery is growing in popularity. Lighting pathways and steps is recommended for safety. Spotlighting fountains, pools, rockeries and small statuary is popular.

Recreation Room—A close-to-the-ceiling type of fixture is desirable, though the modern trend is one or more concealed fixtures built into the ceiling. A number of convenience outlets are necessary for supplementary floor and table lamps.

The recreation room ought to be as gay as can be with plenty of good glareless light.

PROPER ALLOWANCE FOR FIXTURES

When you build your "House of Health", allow at least 2 per cent of the building cost for light fixtures. That's a very small amount for that part of your home which will contribute so much to appearance and to your health, comfort and satisfaction.

A Modern KITCHEN —All-Electric It Costs So Little and Is Worth So Much

● WOMEN EVERYWHERE are intensely interested now in kitchens and are conscious of the contrast between the old and the new, a contrast which includes modern styling, convenience and step-saving; a planned all-electric kitchen which results in more leisure and improved health for the woman who has such for her home workshop.

To build a new home or to modernize an old one without primary attention to the kitchen, its equipment, and the step-saving arrangement of equipment overlooks a first essential. So, when you are building your new home, renovating an old house to make it more attractive to the prospective buyer or renter, or if you are modernizing your own premises simply to make them more livable, *start with the kitchen.* You will begin with the kitchen because it has become the most important room in the house in the eyes of many homemakers. Some years ago the modernity of a home was largely judged by its bathrooms. Today modern bathrooms are taken for granted and the first interest is the kitchen. If a home has a modern electric kitchen many other defects may be readily forgiven—if the kitchen is not modern the whole house is adjudged old-fashioned.

The dimensions, location and fundamental construction of the kitchen become of lesser importance than formerly as compared with kitchen equipment and good planning sense which may be displayed in the location and placing of this equipment. It is possible to have a completely modern kitchen in space 9′×9′ or even smaller. It is usually possible, no matter how kitchen wall space may be cut up by doors, windows or structural projections, to find places for modern equipment in a manner which will save kitchen footsteps and labor.

THREE ASPECTS OF MODERN KITCHENS

1. The alert speculative builder, who must inevitably base his hope of profit on his ability to sell or rent a new property speedily, has been quick to see how great an asset the modern kitchen is. He employs the modern electric kitchen as his most potent sales aid.

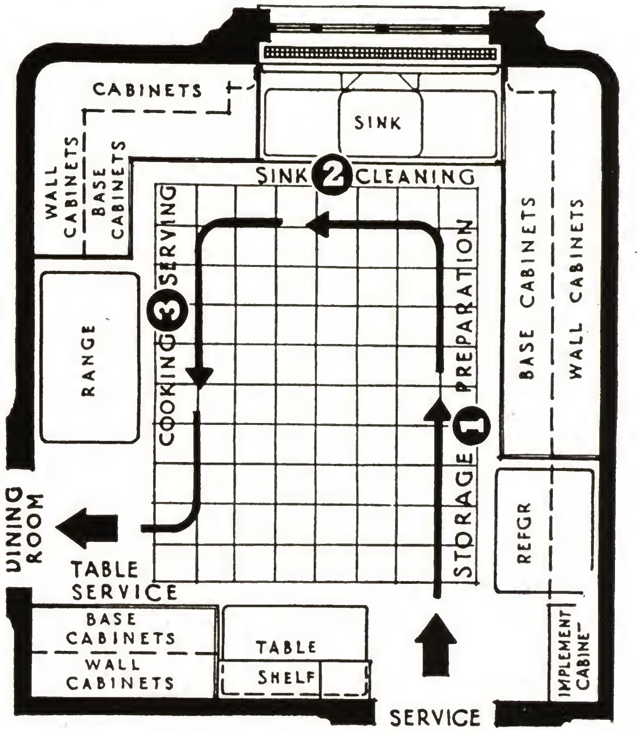
2. Throughout the country are homes from seven to ten years old for which there has been no market during the past several lean years. With the present advent of rising property values and brisker demand, these homes again offer sales possibilities, but in most cases some renovation is necessary to make them attractive either to potential buyers or for occupancy at profitable rental. Owners of these properties are finding that money invested in kitchen modernizing is the surest path to sales or desirable rentals.

3. The homeowner and homelover constantly makes improvements in his or her property as one of the chief sources of family enjoyment. Often these improvements are made, not alone for personal satisfaction, but in the belief that should it ever be desirable to sell or rent the property the improvement would be valuable to this end. Here again, no investment brings greater family comfort and satisfaction than kitchen modernizing. No other investment is so fully reflected in added property value.

THE ELEMENTS OF A MODERN KITCHEN

The necessary elements for a modern kitchen are:

1. Modern equipment, most of which is electrical
2. Step-saving planned arrangement of equipment.
3. Easy-to-clean floor, walls and work counters.
4. An attractive, sanitary ensemble.



In this properly planned kitchen, the three working centers 1, 2 and 3 are arranged so that a map of footsteps would show a logical beaten track in one direction, refrigerator to sink—to range—to dining room and not a hodge podge of criss-cross tracks.

A modernized electric kitchen in which no structural changes were required.

Below, a view of the old kitchen.

A kitchen before and after modernizing. Several structural changes were required, including shifting of windows and installation of flat ceiling, but what woman would not prefer this new electrified workshop?

MODERN KITCHEN EQUIPMENT

The major items of electrical kitchen equipment are the electric refrigerator, range, dishwasher-sink and water heater. To these should be added adequate lighting and wiring and sufficient properly located switches and convenience outlets. Auxiliary electric equipment may include the electric mixer, garbage disposal unit, toaster, ventilating fan, electric clock, coffee maker, roaster and other portable cookery devices.

The nonelectrical equipment includes kitchen cabinets, either of wood or metal and properly fitted to the available space; easily cleaned, durable floor covering, such as laid linoleum or rubber tiling; washable wall surfaces—paint, waterproof fabric, baked-enamel metal, stainless steel, and various ceramic and vitreous finishes; work counters with easy-to-wash surfaces.

KITCHEN PLANNING AND ITS IMPORTANCE

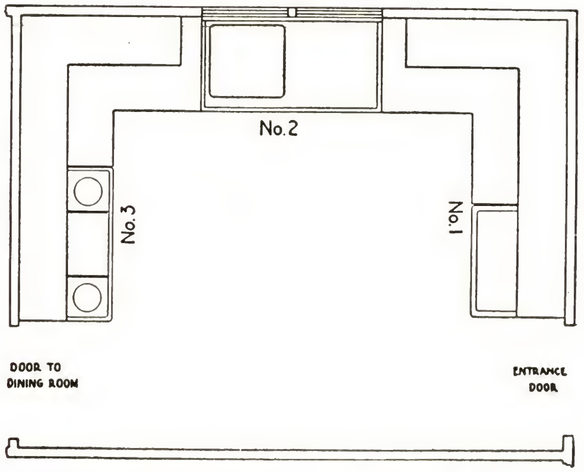
Quite as important as modern equipment are the care and intelligence with which each item is located in the kitchen to save footsteps and eliminate all unnecessary kitchen labor so that more leisure hours may be enjoyed.

Kitchen counsellors divide the kitchen into three working centers:

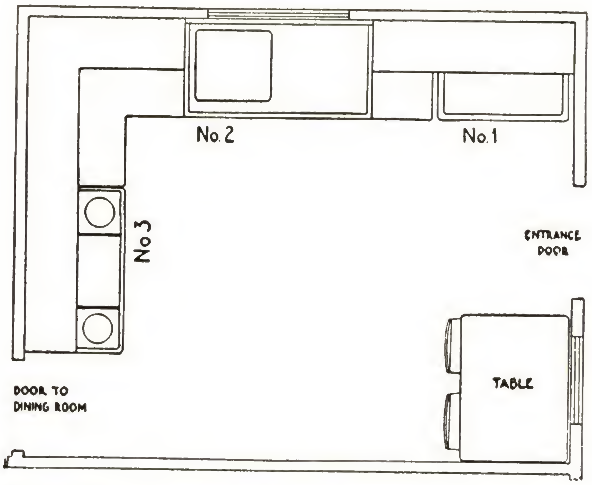
1. The storage and preparation center.
2. The cleaning and disposal center.
3. The cooking and serving center.

The storage and preparation center represents food storage and food preparation and includes the refrigerator, adjacent work counters, and cabinets to contain staple nonperishable foods and utensils. The logic of grouping these things close together as a means of saving footsteps and kitchen time is obvious. Investigation shows that failure to group and concentrate these elements is responsible for more wasted time and effort in kitchens that are not modern than in any other modernizing factor.

The cleaning center, which consists of the sink, adjacent work counters, and upper and lower cabinets, should be between the storage and preparation center and the cooking area so as to be equally handy to either one.

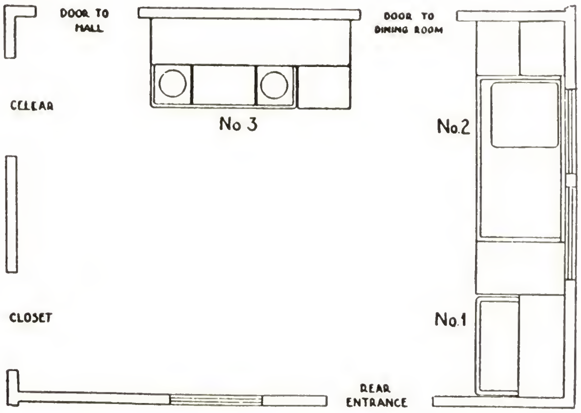


U-shaped arrangement of kitchen equipment. (No. 1 is the refrigerator-food preparation center. No. 2 is the cleaning center. No. 3 is the cooking center.)



L-shaped arrangement of kitchen equipment. (No. 1 is refrigerator-food preparation center. No. 2 is the cleaning center. No. 3 is the cooking center. Note breakfast nook in lower right corner.)

The cooking center consists of the range, serving counter, and cabinets.



Broken L-shaped arrangement of kitchen equipment. (No. 1 is refrigerator-food preparation center. No. 2 is cleaning center. No. 3 is cooking center.)

The kitchen planner, in attempting to place the three working centers for any kitchen, begins with three ideas in mind:

1. If possible, to place the sink under a window.
2. To place the range near the door to the dining room.
3. To place the refrigerator near the outer or service door.

The planning task is to accomplish the aims, keeping the cleaning center intermediate between refrigerator and range and allowing for necessary cabinets and working counters in proximity to the working centers. Often in the already-built kitchen compromises of some sort must be made because of location of doors or other structural obstruction. Not infrequently some simple structure change can be made which permits ideal arrangement of kitchen equipment that would not otherwise be possible.

In planning the new house it is now inexcusable on the part of architect or builder not to take into account the ideal placing of kitchen equipment and to provide a kitchen design in accordance.

There are four general types of good arrangement for kitchen equipment. These are known as U-shaped, L-shaped, parallel and straight line.

The U-shaped arrangement is generally conceded to be the most perfect. In this arrangement equipment is placed along three walls. The refrigerator-preparation center along one side of the U, the cooking center along the opposite side of the U, the cleaning center under a window and at the bottom of the U. In addition to providing a perfect sequence and correlation of kitchen operations, this arrangement usually leaves a portion of the kitchen free for a breakfast nook, unless the kitchen is very small.

In many kitchens the U-shaped arrangement is impossible to employ and an L-shaped arrangement is used, with equipment placed against two walls, refrigerator at one end of the L, range at the other end, and sink somewhere between and under a window.

Another common arrangement is the placing of all equipment along parallel walls.

The broken-L and broken-U shaped arrangements are sometimes employed where an intervening door makes the uninterrupted arrangement impossible.

The final frequently used arrangement is the straight line along one wall. It may be used in the small kitchen or in an unusually narrow kitchen. It is a common arrangement for kitchens in small apartments.

KITCHEN–PLANNING SERVICE

Many electric utility companies have instituted a service on kitchen planning where expert advice on kitchen planning and also the drawing up of plans for any specific kitchen may be obtained. Likewise, electrical dealers and distributors frequently either have competent kitchen service of their own or have access to the excellent service. If you desire assistance in planning an electric kitchen, go to your lighting company or electrical dealer. Such assistance is either free or provided at very nominal cost.

Recently issued by the National Kitchen Modernizing Bureau, 420 Lexington Avenue, New York City, is a 72-page book entitled *Planning Manual for Electric Kitchens,* containing 50 typical kitchen plans, numerous photographic reproductions of "before" and "after" kitchens, planning information, color schemes, etc. It may be obtained by sending 60 cents to the above address.

STRUCTURAL AND OTHER CHANGES

The structural changes most commonly called for in existing kitchens in order to make possible an effective arrangement of kitchen equipment are:

Relocation or addition of windows.
Relocation or sealing up of doorways.
Abolition of separate pantry space.
Removal of wall obstructions or building out of walls to provide an uninterrupted surface against which equipment may be placed.

In addition, some changes which are not strictly structural changes are sometimes required. These include the furring down of walls to meet the tops of built-in cabinets so as to leave no dust-catching space, relocation of radiators and plumbing connections, rewiring of the kitchen.

In nearly all cases, changes in lighting and wiring are necessary to modernize an old kitchen.

NONELECTRICAL EQUIPMENT

It is not the purpose of this article to go into any detail concerning nonelectrical equipment. The one item of such equipment which calls for consideration in the basic planning consists of base or underneath cabinets and wall or upper cabinets. These are, as previously stated, either of wood or metal. They may be made to order, or standard ready-made cabinets may be used. Sizes of standard cabinets may be found from manufacturers' catalogs.

The generally accepted basis for planning the amount of cabinet storage space to allow is given in the following table:

Kitchen Storage Requirements

No. of Bedrooms in Home	Upper Cabinet Storage Space (Square Feet)	Base Cabinets (Linear Feet)	
		Min.	Max.
1	24	3	4½
2	30	4½	6
3	36	6	7½
4	42	7½	9
5	48	9	10½

ELECTRIC REFRIGERATION

A reliable electric refrigerator brings truly adequate refrigeration as a boon to the family and as a guardian of family health. Automatically, dependably, constantly, it maintains a temperature below 50 degrees—a necessity for the safekeeping of perishable foods.

The electric refrigerator keeps milk and cream sweet for days; vegetables retain their freshness, and uncertainties in food preservation are eliminated. A definite saving in food costs is possible for the woman who will purchase food in quantity at week-end special prices and store it in her refrigerator for future use. Thus, trips to the stores are lessened. It enables the homemaker to add to her menus a wide variety of inexpensive frozen salads and desserts, any of which can be prepared in advance and kept in the refrigerator until wanted. It provides ice cubes for cooling drinks. It is easily kept clean; it requires a minimum of attention.

In allowing space in kitchen planning, it is usually advisable to allow ample room for the refrigerator. In the past the tendency has been to purchase electric refrigerators of smaller cubic capacity than the family could well use. As these are replaced, larger sizes are usually purchased. In general 2 to 2½ cubic feet of refrigerator storage capacity per person in the household may well be allowed in planning.

ELECTRIC COOKERY

The electric range has many desirable advantages. An oven meal may be placed in the oven, the automatic timer set, and the homemaker is at liberty for the afternoon, knowing that she may return home just before dinner and that a delicious meal is ready to take from the oven and serve. Cookery on the electric range may be controlled as occasion requires, but is always certain as to results because of controlled even heat. Electric cookery is sootless and clean, and, because of excellent insulation, no heat is wasted. It does not heat up the kitchen—a great asset in summer.

Electric ranges, like electric refrigerators, are made in a variety of styles and sizes, dimensions of which are available from manufacturers' catalogs.

THE ELECTRIC DISHWASHER-SINK

The electric dishwasher-sink marks any kitchen as modern. To look even a little way into the future, it is safe to say that it will soon be as customarily found in kitchens as the electric refrigerator is today.

The advantages of the electric dishwasher over and above the thrice-a-day saving of time to the homemaker are:

1. It is more sanitary. Dishes are washed in hotter water. They wash and dry without the touch of dishcloth, towel or hands.
2. Hands do not have to be disfigured by contact with hot soapy dishwater.

Electric dishwashers are available either separately or built into the sink.

A new and practical device for the sink is the garbage disposer. It grinds up garbage—even bones—and flushes them down the waste pipe. The waste is so completely pulverized that there is no danger of clogging the pipe.

HOT WATER

Essential to the modern kitchen is automatic, instant hot water. The supply must be unlimited, and it should be possible to regulate easily, at will, the degree of heat. One excellent way to meet this need is the installation of an electric water heater. The heater may be installed either in the kitchen or basement. The small floor space required, together with the modern appearance and gleaming, easily cleaned porcelain finish of the electric water heater, renders it thoroughly harmonious for installation with other electrical equipment.

LIGHTING

Good lighting is most essential to the modern kitchen. There should be enough light so that an ordinary printed page may be easily read anywhere in the room. The light should be so diffused that there is no harsh glare—no sharp shadows. In most kitchens both general and localized lighting units are necessary. General lighting may be from a central ceiling fixture enclosed in diffusing glassware, from cove lights or inset panel units.

Localized lighting is frequently required over work counters, sink or range. Each of these units should have its own handy wall switch.

Nothing is more aggravating than groping about an unlighted kitchen for a pull-chain lighting unit. Switches for all general kitchen illumination should be conveniently placed near a doorway.

WIRING

In the still-to-be-built house it is assumed that adequate wiring will be provided. In the old kitchen which is to be modernized it must not be overlooked that any addition to present electrical equipment will probably overload kitchen circuits which may be already inadequate. Consideration of the wiring both for safety and economy of operation is necessary.

TIME PAYMENTS

Electrical equipment for kitchen modernizing is purchasable on time payments. In some cases, electric-lighting companies and electrical dealers have established financial arrangements whereby the entire modernizing of the kitchen, including electrical and nonelectrical items as well as labor, may be purchased on time payments.

STEP-BY-STEP MODERNIZING

The homeowner may not want to modernize the kitchen in one complete operation. He first should have a complete plan before making any expenditure and he should see that each purchase fits exactly into the prearranged planning. Then one item at a time may be purchased and installed.

GAS
In Your Kitchen

● FOR THE MODERN GAS KITCHEN the gas range is the focal point around which this new kitchen should be designed. Not only is a great part of the homemaker's time spent in the kitchen, but it is time devoted to the vital task of preparing tasteful, health-giving and enjoyable foods for the entire family. The range is the scientific center of this activity and this makes it, at once, the most important and the most fascinating appliance in the home. "Be an artist at the gas range," says the Mystery Chef, "and learn the joys of cooking."

From the homeowner's point of view, knowledge of the new developments in gas ranges is helpful to aid in the selection of the best equipment. Of course, all modern ranges are equipped with oven heat controls and many of them have timing devices, such as minute reminders and clock controls. The latest ranges have ovens which can produce temperatures of 500° within ten minutes and still be operated at extremely low temperatures of 200°–250°, thus permitting a greater accuracy, as is required, for instance, in the making of fruitcakes.

The broiler, too, has been improved in the newer ranges, being equipped with a special mechanism to simplify the broiling job. Broilers elevate like an old-fashioned piano stool, or rise upward and outward as the door is opened, or are attached to the door in some instances.

Accessories, too, are as important in the modern range as they are in modern dress. Look for some of the following features on new ranges: economy cooker; deep-well cooker; Dutch oven; top-stove griddles; salt and pepper shakers; mirrors; recipe hooks; and lamps.

Style trend is toward simplicity and eye appeal as well as more sturdy construction. White porcelain enamel is the current style, while color may be introduced in handles or by strips of metal. The tabletop type is the most popular, but, if desired, a range with the oven slightly elevated above the top-burner level can be secured.

The gas range alone does not provide everything. The kitchen, as a whole, needs the proper treatment to make it a convenient, cheerful, comfortable and effective place to work in. For this purpose, it is customary to divide the kitchen into six or more typical parts, the "work centers," and plan to fit these together into a unified and balanced whole.

Accepted practice names these parts as follows:

1. FOOD-STORAGE CENTER

The modern silent gas refrigerator is the principal appliance, but space for dry materials and nonperishable foods must also be provided. Sometimes it is convenient to provide a rolling table to facilitate work and transfer of foods to and from the food-storage center.

Gas Refrigerator

The very silence of the gas refrigerator is a promise of its lasting efficiency. The modern gas refrigerator is air cooled and operates on a tiny gas flame that requires from 7½ to 11 therms of gas per month, depending upon its

Modern gas kitchen showing cleaning, range and work centers in a convenient, compact layout.

The silent gas refrigerator offers a practical economic solution for your perishable food storage and ample ice-cube supply.

size and the room temperature. The freezing unit inside is designed for easier removal of ice cubes, and a fast freezing compartment is provided for frozen desserts.

In selecting a gas refrigerator several points may be kept in mind:

1. That either a right-hand or a left-hand door may be obtained. The correct choice depends upon the kitchen design and not upon left-handedness or right-handedness of the homemaker.
2. The right size for your needs. While the gas refrigerator is available in units having storage capacity of 3–10 cu. ft., it is suggested that the smaller sizes only be used when it is impossible to adopt a more adequate size. The difference in operating cost between the various sizes is slight, making it desirable to provide ample refrigerator capacity for your kitchen.

2. FOOD-PREPARATION CENTER

Typical arrangements provide a hollow square formed by the parts of the kitchen and thus the worktops and cabinets used for food preparation can be conveniently located along one wall adjacent to the sink and drainboards. Worktops combine with cabinets, shelves and storage space for utensils, drawers, etc. This section should be adequately lighted, ample in size, and of proper height.

3. FOOD COOKING CENTER

The snap judgment a casual observer gives a kitchen relates to its color and charm, or lack of them, rather than to the arrangement of the equipment or individual units. The artistic home should have a distinctive and colorful setting for the modern appliances, because a homemaker appreciates the value of a wise color scheme and knows that mediocrity results from a poor choice, reflecting upon herself. The kitchen, designed for so much of the home life, schould have a certain color vigor which can be injected merely by way of accents and accessories. For the doubtful, it is safest to add bright color notes in a white kitchen rather than to offend good taste by a splashy background that will soon be tiresome.

For example, the modern automatic gas range and the gas refrigerator in white porcelain enamel in a white or light-toned kitchen may have bright red handles. This is the cue for bright red and white accessories with a deft touch of vivid blue or black. Handles, hinges and borders may be given such touches. There is strength and character in the use of black.

The position of the kitchen in the house generally determines the deft tone in the background coloring. A room with a northern exposure needs a warmer tint than a room with plenty of sunlight. For the northern kitchen, a yellow ceiling or any light warm tint will lend a pleasant glow to the walls, especially near the shadowy tops. Light yellow will also tend to enlarge the space of a small kitchen by diffusing the light, while dark tones will seem to decrease it. If pale shades are preferred in the background, natural light is needed to appreciate the color, and the stronger the daylight the more perfect must be the finish of the walls, woodwork, equipment, and kitchen appointments, since every blemish is revealed.

Color schemes must be chosen in relation to artificial light as well as to daylight, since they change under the various light conditions. Clear blue, so attractive in the day, may take on a most undesirable brownish tinge in certain artificial lights, and at night dark blue will have even more depth than black. If a natural shade is selected, because of the possibility of using colorful accents, it must be borne in mind that solid pale coloring tends to fade the coloring of the homemaker herself when she works in the room.

A point to remember about wall finishes is that shiny surfaces and glossy paints make the rooms seem brighter and more attractive but the high sheen is harder on the eyes than the softer surfaces when you have been in the room for some time.

The Gas Range

The heart of the kitchen, the modern gas range, requires careful location and proper accessories. Work space at the same level as the cooking surface and additional storage space for pans, roasters, kettles and utensils beyond that in the utility drawer of the gas range should be provided. A combination of shelves and hooks makes such a pan closet most convenient. Overhead a wall cabinet for additional dish storage and storage of dry material like crackers, cereals, etc. affords added convenience.

LOCATION OF GAS RANGE

As the focal point of the kitchen, the gas range must be given careful consideration. Where shall it be put for the most effective, convenient cooking? The first choice of a location will probably be dictated by the presence of an available flue—note carefully the next section on flue connections.

If the location of the flue does not decide where to put the gas range then the following points will be helpful. The cooking surface should be entirely accessible and well lighted by natural light during the daytime and artificial light at other times. The range and the floor around it should be accessible for cleaning. It should be located

New convenience in broiling assured by the smokeless pan and the new principle of radiant high heat utilization.

so that opening or closing doors will not graze so close to the gas range that someone's fingers may be caught.

It is most important that ranges be set so that the cooking tops and oven racks are quite level. Settings should be made with a level. This is to assure good baking and roasting; an oven that is not level might cause dough to overflow the side of a baking tin. Ranges with insulated ovens and flue connections can be set flush against brick, protected wood or fireproof walls, but it is customary to set them 3 in. away if not flue connected. In the case of unprotected wood, a 6-in. distance is customary practice.

FLUE CONNECTIONS

The purpose of a flue connection from a range, regardless of the fuel used, is to carry off the warm, moist, greasy odors and vapors which are produced from the food during baking, roasting and broiling operations. In order to keep these from getting into kitchens, and especially to keep them from condensing on the cooler wall back of the range, it is desirable to have a flue connection whenever this is available. Not only are these vapors carried off by such a flue but the heat in the oven will be carried away too. Sometimes undue emphasis is laid on the latter. The stored heat in the oven insulation is not very great, but whatever the source of heat for cooking, this stored heat will eventually find its way into the kitchen unless the range is flue connected. However, the ranges approved by the testing laboratories of the American Gas Association can be installed without a flue connection unless local building ordinances provide otherwise.

FEATURES OF THE GAS RANGE

The automatic, completely insulated and heat-controlled gas ranges provide the most modern and yet the most economical cooking. The striking advantages of speed, flexibility of heat at any desired degree, and better oven and boiler temperature control are obvious advantages; and, in addition, low operating and first costs are available only through the gas range. Past experience has already shown that maintenance is practically negligible as far as the gas range is concerned, and newer ranges have added features in this respect because of their porcelain enamel finishes and their corrosion-resistant metal parts. The gas range is not only modern when you buy it but will remain modern for years to come.

The question is often asked what are the relative costs of gas and electric ranges and water heaters. Authentic repeated tests by universities, gas and electric companies, as well as data collected by the government, have established the fact that the following fuel equivalents are representative values:

COOKING

1000 cu. ft. of mfd. gas (530 Btu) = 77½ K.W.H.
1000 cu. ft. of mixed gas (850 Btu) =125 K.W.H.
1000 cu. ft. of natural gas (1100 Btu)=161 K.W.H.
(Includes gas for pilot)

WATER HEATING

1000 cu. ft. of mfd. gas =122 K.W.H.
1000 cu. ft. of mixed gas =195 K.W.H.
1000 cu. ft. of natural gas=253 K.W.H.
(Based on heating 50 gallons water daily.)

Local rates charged by your utility companies applied to these equivalents show how economical gas is in comparison with electricity. Cost of operation, however, is only one item to be considered. Gas appliances styled by experts in the most modern manner are priced considerably lower than corresponding competitive equipment. They are available from about $40 up and are generally installed free or at nominal expense.

Homemakers often ask about oven temperature control and food shrinkage, both of which have been featured in certain unethical advertising. The truth about shrinkage has been thoroughly aired by the National Livestock and Meat Board, the Bureau of Home Economics of the United States Department of Agriculture, and others. They have shown that shrinkage is independent of the fuel; that it consists largely of water and fat, a considerable portion of which is recovered in the drippings which make the gravy.

Assuming that the same food is being cooked, the amount of shrinkage will be found to depend upon the time and the temperature at which the cooking is done. It does not depend upon the equipment in which gas ovens are controlled with a "throttling" type heat control so that the temperature in the oven is maintained at the exact desired level. If this type of control is compared with the "all-on all-off" type, it will be found that ovens regulated by the latter will fluctuate in temperatures up and down, 25° or more, as the control snaps on and off.

The features which the modern gas range offers are so new that they are changing the very concepts of cooking. In 1936 something over one million six hundred thousand American homes were equipped with gas ranges embodying these developments. Most interesting is the fact that the modern ranges permit more than 20 per cent extra cooking to be done with the same amount of gas that is used in older ranges. Multiflame top burners bring this about and, at the same time, give any speed of heat from immediate full heat to a mere pin point for simmering and stewing. Many of the gas ranges have special simmer burners to give still better service for such work. Others have deep-well thrift cookers designed for slow stewing and simmering with a number of pots in the cooker at the same time. Burner bowls and improved finishes with their smooth surfaces make cleaning and care of a gas range far easier, especially in comparison to ranges heated by old-fashioned spiral hot-metal heating coils.

And then we have separate new high-speed broilers for faster, smokeless broiling. Should a steak be your favorite dish, the new radiant-heat gas burner offers the only modern version of the old-fashioned charcoal broiler. Engineers tell us that these new broilers reach 700° in ten minutes. Speed, though, is not their only advantage, for broiler pans swing and slide in ingenious new ways, making healthful broiled foods easy and certain to prepare.

The words "smokeless broiling" puzzle some. New broilers really are smokeless, because small holes or narrow slits in the broiler rack allow fat to drip through in the lower pan, where it is not subjected to the high temperature of the broiler. Therefore, it does not smoke.

For comfort the homemaker wants a range with a thoroughly insulated oven and, of course, a heat control. If desired, clock controls are available. The automatic time control liberates the cook and makes gas truly your servant—silent, trouble free, and always on the job.

Modern gas ranges are built to meet all dimension requirements and every style or color needed to fit the design of your kitchen. No feature has been omitted which would add to your comfort and convenience in using gas, the fuel that cooks fifteen million dinners every night.

4. CLEANING CENTER

The sink and the drain boards of modern design fit with worktables or the cooking surface of the gas range with tight contact and without the inevitable gap occasioned by the older types of deep-rolled apron cast-iron sinks. Utility drawers and a compartment below for the garbage can are available.

5. PLANNING AND SERVING CENTER

To complete the kitchen the homemaker will want a little place all her own for planning. Here we can place a chair or stool—don't forget the knee room—and provide shelves for recipe books, papers, and a phone and radio.

For serving there should be storage for dishes, table utensils, trays, etc., to make the last step in serving prior to the meal convenient and accessible.

6. WATER HEATING

While the water heater is not generally installed in the kitchen, the need for automatic hot-water service in the modern home is so evident that the story of gas would be incomplete without reference to it. The equivalent of gas and electricity for water heating, shown previously, is derived from the comparative tests made by Professor Wilkes of Massachusetts Institute of Technology on all forms of water heating. They are the most authentic tests in which all fuels were compared on an equal basis. Your gas company can give you these results and also reports on every possible method of water heating if you ask them about it. The gas water heater for the home is available in a number of types offering minimum-low-cost hot-water supply of unlimited hot-water service as desired to fit the needs of your home. There are units to fit every pocketbook, both from a first-cost and an operating-cost viewpoint.

The water heater would normally be installed in your basement, but in some of the cellarless homes there are water heaters designed as worktables to fit right into your kitchen scheme which can be used. General points to remember about your water heater are to install it as close as possible to the point of greatest use, which is generally the kitchen.

These few printed words can only hope to whet your appetite, like the aroma of good cooking. There must be hundreds of questions and ideas that come to mind as you picture your "House of Health." Every utility company has experts ready to help and serve you. Why not tell them about your plans and let them advise and assist you? They are ready to serve.

A LIBRARY FOR THE HOUSE OF HEALTH

The House of Health will have bookshelves, for a home without books is not completely furnished. Modern architecture has found many places for shelves: under the stairs, between windows, under and above window seats, and many other places in addition to the more orthodox bookcases. Shelves of the latter should always be adjustable, for many of the books of today are oversize and need more than regulation height if they are to be stood upright.

Today a good library is not beyond the means of any householder. Many books that were formerly a luxury are now available at modest prices. In fact all the classics and most of the best of recent works are available in inexpensive form which, while much cheaper in price, are generally just as good if not better than the original editions in the matter of paper, printing and binding, and are a credit to any library, both in selection and appearance.

For example there will be found in varied colored covers among the famous "Sun Dial Books" the best in recent fiction including romance, adventure, detective stories, as well as classics by famous authors such as Hugh Walpole, Conan Doyle, O. Henry, etc., done in gold stamped uniform bindings all priced at less than $1.00 each. Then too there are the "Star Books" in which are found the great books of biography, travel, history, science, literature, as well as essential guides such as Ida Bailey Allen's Modern Cook Book, The Modern Guide To Successful Gardening, Gardening Short Cuts, etc. These new editions are uniformly priced at $1.00.

Those who can afford a little more will find the "De Luxe Editions" (less than $2.00) of the Garden City Publishing Company well worth owning. These books offer most extraordinary values in really beautiful books on a variety of subjects including interior decorating, antique furniture, art, landscaping, gardens, flowers, and many practical and educational subjects. Durably bound in fine and colorful cloths, stamped in gold foil, and profusely illustrated, they not only add a note of culture and refinement to the home but add an important note to the decorating scheme of every room.

They are obtainable wherever books are sold and any book or department store will be glad to advise you on selection. The publishers of this booklet will be glad to supply you with illustrated catalogues and the name of your nearest dealer, without obligation.

MODERN GAS RANGES Offer New Automatic-Cooking Facilities

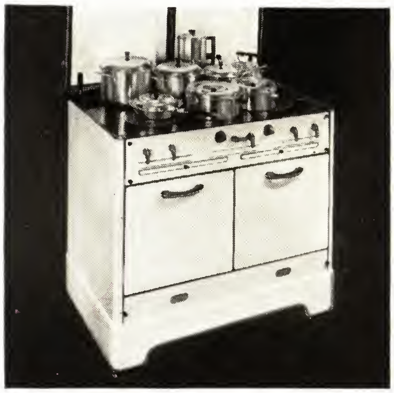
● THE modern gas ranges, illustrated here, combine the instant intense heat, great speed, flexibility and cleanliness of gas with automatic control and many conveniences. Some of the advanced features include spring-balanced lift covers; automatic top burner lighters; Speed-Simmer burners that give high speed when needed, or a simmer flame that uses almost no gas, for waterless cooking, stews, etc.; automatic oven-heat control (time control if desired); smokeless broiler in roller-bearing drawer; thick Rock Wool insulation around oven and broiler; sandwich grill; safety oven and broiler gas cocks; safety oven racks; new oven burner that heats oven at high speed, suitable also for low temperature roasting to reduce meat shrinkage. Porcelain enameled inside and out, they are easy to keep clean.

Details on these and many other styles and sizes of ranges will be supplied by Standard Gas Equipment Corp., 18 East 41st St., New York. Sold under names Oriole, Vulcan and Acorn.

Many do not realize the great improvements in automatic and other conveniences that have have been made in gas ranges.

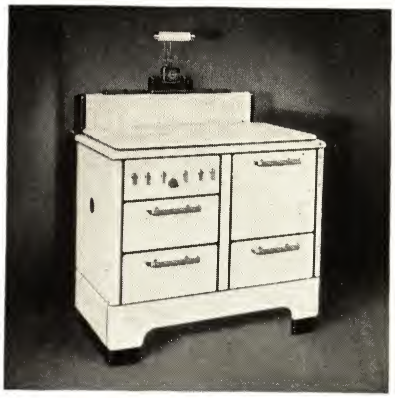
Gas ranges have also advanced greatly in design and beauty, due to the work of Norman Bel Geddes (who designed one of the ranges illustrated on this page). They are now used in the finest model kitchens, and harmonize with the latest developments in kitchen equipment, cabinets, etc., as will be noted.

SOME EXAMPLES OF THE LATEST DEVELOPMENTS IN GAS RANGES



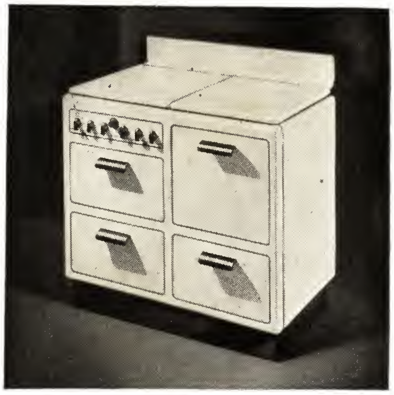
Smoothtop, with 3-Zone Top Heat

Has enameled, closed top, same type used by famous chefs. Three-Zone Top Heat—boiling, simmering and warming heats from one burner at one time. Top holds eight to twelve utensils. Two large ovens and broiler. Three sizes—elevated warming closet in large size if desired.



A New 41" Tabletop Range

A new, moderately priced, 40" range with every modern de luxe convenience, including aluminum Speed-Simmer burners automatically lighted, new oven burner, and other features described above. Refrigerator type base, chromium-finished handles. Lamp clock and condiment set.



Designed by Norman Bel Geddes

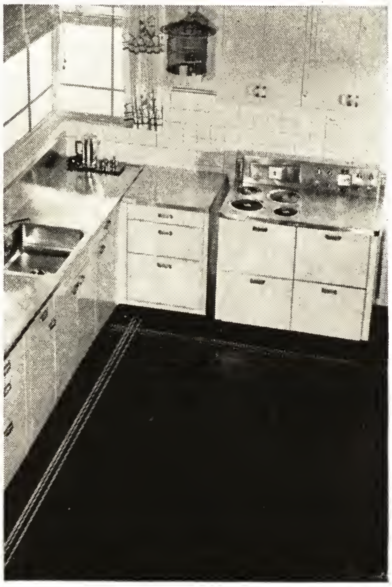
Considered the most beautiful range made. Widely used in model kitchens. Includes best suggestions of 1200 women. Substantially constructed and completely equipped with de luxe conveniences. Supplied with Monel Metal or stainless steel tops if desired. Range is 40" wide. Ivory or white enamel.

The Hostess of "HOUSE OF HEALTH" Keeps the Kitchen Door Open.

● THE SHRILL br-r-r-ing of the doorbell announces the arrival of the Shannons. They're going to be dinner guests. The hostess shouts to the cook. The host shouts to his wife. The cook shouts to Billy. And finally the kitchen door is closed before the guests enter the house. Sighs of relief.

This unnerving ordeal is a common thing—or we should say *was* a common thing—in many homes. If intimate guests, like relatives, were coming, who you knew would go prying around the kitchen, then the range had to be burnished and blackened, the sink had to be scrubbed, and pots and pans had to be concealed in uncertain hiding places. A half day's work before the cooking of the meal had started.

For years this sort of thing went on and on and on until one day a number of people simultaneously voiced their disapproval. Their voices were the spark that set manufacturers on fire with enthusiasm for newer, better kitchens. Kitchens that bid cheery welcome to all comers. Kitchens that ousted drudgery and replaced it with every convenience. And kitchens that were as tastefully decorated as any room in the house. And these manufacturers have achieved their aims. Not, of course, without the help of various research groups and women associations.



First, they decided that cooking should be less of a burden. They straightway invented stoves that cooked meals while the housewife sewed or played bridge. Then, refrigeration. The coming of summer always meant frantic calls to the local ice dealer at some unearthly hour of the day. That wasn't right. So they invented automatic refrigeration. And then came enclosed cabinets to hide pots and pans. Removing these utensils from the class of wall decorations was the longest step toward beautifying the long neglected kitchen.

But there was still something lacking to complete the metamorphosis of the kitchen. Something—but what was it? It must be the sink and the working surfaces. Yes, that was it. They were probably overlooked because hard abuse of preparing and cleaning up meant certain defacement for any material that might be used. At least, that was the popular opinion. There was nothing to turn to—nothing that could keep step with the new, attractive appliances.

Then a silver lining showed itself on the dark cloud hovering over the kitchen. The International Nickel Company in 1931 announced the development of a Monel kitchen sink. After the sink came cabinet tops, table tops and range tops, kitchen utensils and range hoods.

International Nickel is an industrial concern and for many years has sold Monel to every prominent hospital, hotel, restaurant, ocean liner and railroad train in the country for kitchen equipment. The Waldorf-Astoria, the Cornell Medical Center, the Savarins, the Queen Mary and the 20th Century are all users of Monel for food service. Monel proved itself capable of maintaining its inviting silvery beauty despite harsh commercial use, and, therefore, was the logical choice to solve the working surface problem for the domestic kitchens. The choice takes credence when it is revealed that nearly every "model" home has used the eye-appealing Monel for the kitchen.

Today, there are complete kitchens available including sink, cabinet tops and range tops of Monel, that can be planned free of charge for all those interested. Fifty-seven different models of sinks leave little to be desired in so far as choice of shape and type of sink is concerned. The Whitehead Metal Products Company, sponsors of the kitchen planning service, can provide complete information on all-Monel kitchens. Information about Monel-topped ranges can be obtained from any of the large manufacturers or your local dealer or utility. The Monel-topped kitchen tables are made by the famous Mutschler Brothers at Nappanee, Indiana. The circular picture on the next page shows their popular "Smartline" Monel table which has provided many with a "first" item to start them on their way to a completely modern kitchen.

Complete "before and after" view of a typical kitchen. Modernizing this room cost but half of what a new low-priced car sells for.

Happy hearts find appropriate surroundings in this modern Monel kitchen.

Another "before and after" view showing how simple kitchen modernization can be. New appliances and work surfaces are now made so that no elaborate structural changes are necessary to bring the kitchen up to date.

What is MONEL?

Q. What is Monel?

A. It is a solid metal—an alloy composed of 2/3 Nickel and 1/3 Copper.

Q. Is it a new metal?

A. No—it is 30 years old. It was put on the market in 1905, but was not used extensively in the home until about 1930.

Q. Does it rust?

A. No. Being composed of Nickel and Copper and containing only about 1% iron, it cannot rust.

Q. Does it stain?

A. Not permanently. Fruit juices or milk, if left on it for long periods, may discolor it, but—the discoloration is easily removed with ordinary household cleansers like Bon Ami, Old Dutch Cleanser, Babo, etc.

Q. Will it scratch?

A. Yes—do you know of anything that won't, excepting, perhaps, a diamond? But the scratches on Monel are light and they blend in with each other to form an entirely new finish which becomes more beautiful the more the surface is used.

Q. Will it dull down or will it keep its silvery appearance in service?

A. It will become brighter in use and will actually look better after years of service than it does when new.

Q. Is it hard to keep clean or does it require polishing?

A. No. Simply use ordinary household cleansers in the regular way. Finish wiping with a cloth free from grease and wring it out as dry as possible to avoid streaking.

Q. Is it strong?

A. Yes—stronger than the steel used in railroad bridges.

Q. Will hot pots and pans harm it?

A. No. You can put hot pots direct from the stove on Monel.

Q. Can food such as meat and bread dough be left in contact with the bare top any length of time, or would it taint the food?

A. This Metal does not contaminate or taint food. That's why, for thirty years, it has been used in food packing plants like Beechnut, Armour, oyster plants, etc.

Make the KITCHEN a Perfect WORKSHOP

● IN PLANNING your "House of Health", don't skimp on your kitchen. Next to your bedroom, your kitchen is probably the most lived-in room in the house. The kitchen is the housewife's workshop—the place where she spends many hours of the day, planning and preparing her family's meal. It should be bright and cheery, planned and equipped to make work easier and to reduce the hours of kitchen efforts.

THE KITCHEN OF TODAY

Three things distinguish the modern kitchen of today. New materials—new equipment—and correct kitchen planning. The newest of those materials used in the kitchen (although it has been tried and tested in industry for over thirty years with remarkable results) is Monel. Monel is an alloy of two-thirds nickel and one-third copper. It is harder than steel, cannot rust, chip or crack, and will not stain. It is not a coated surface but a solid metal all the way through. It has a bright silvery luster that blends with and enhances any color scheme you choose for your kitchen—and it is kept clean with the usual household cleansers.

Monel is essentially a working-surface material, and as such has been adapted by the Whitehead Metal Products Company of New York, Inc., for the manufacture of a complete line of Monel sinks and cabinet tops.

CONSTRUCTION AND APPLICATION

This Monel kitchen equipment is truly modern in design. All the resources of prominent kitchen architects and home economists, as well as the practical experience of many housewives, are reflected in its construction and design. The sinks have many outstanding advantages. Aside from the beauty and easy-cleaning features of the metal itself, the most important advantage to the housewife is that the sinks are scientifically built and installed at the proper height for easy work. There is no backstrain or fatigue, and kitchen work is done in comfort and in faster time.

Other advantages that women have been demanding for years are also embodied. For instance, the back is built in one piece, with no cracks to collect dirt; the pedestal faucet permits mixing hot and cold water to the desired temperature and allows swinging to either side; the soap dish and glass rest are an integral part of the sink deck; and the edges of the deck are slightly raised to keep water from dripping on the floor. In addition to all this, the steel cabinet base on which the sink rests is set back from the front to allow toe room in working close, and the space beneath the sink bowl and beneath the drainboards is a complete cabinet unit for the storing of kitchen utensils.

THE COST IS NOT LARGE

Contrary to popular belief, Monel sinks are not expensive. They are manufactured in fractional inch sizes from 48″ to 144″ in length, adaptable to the needs and space requirements of any size kitchen, be it small or large, and meeting the limitations of every pocketbook.

The advantages of Monel as a working-surface material have also been extended to the rest of the kitchen. The Whitehead Metal Products Company of New York, Inc., also manufactures a complete line of Monel cabinet tops from 15″ to 144″ in length, matching in width their Monel sinks, and adapted for their line of steel cabinets that are especially designed to fit under both Monel tops and sinks. Monel tops provide an ideal surface easy to clean and sanitary to work on. You can prepare salads and other dishes directly on the Monel surface with perfect safety.

STEEL CABINETS SANITARY AND DURABLE

The kitchen of today has all its pots and pans, package goods, and bulk staples well out of sight for neatness and cleanliness, yet stored at the point of use for efficiency and for worksaving. Here again the modern trend is toward new materials, and steel is the accepted material for kitchen wall and base cabinets. Steel cabinets are fireproof; they are absolutely sanitary and exceptionally easy to keep clean. They are available in sizes to fit every requirement of the Monel sinks and cabinet tops described above, as the same company manufactures a complete line of all steel cabinets to fit their line of Monel sinks and working surfaces. Cabinets are finished in baked enamel in standard colors, a finish both beautiful and easy to keep clean.

A KITCHEN-PLANNING SERVICE

The third requirement of the modern kitchen is correct planning. Planning services are available throughout the country to help you plan your kitchen. The Whitehead Metal Products Company has such a service set up in each of its offices throughout the entire country. This service has been established for the sole purpose of showing the housewife how she can transform her kitchen into a really enjoyable part of the home, an efficient workshop and a new guest room all in one. A simple sketch of your kitchen showing the floor plan and the present equipment will result in your receiving a complete plan, and estimate as to cost, of your kitchen as it really could be. This service is without obligation to you.

The Magic of COMPOUND INTEREST

● COMPOUND INTEREST is interest paid on the original amount invested, plus the interest already earned. Interest when added to the principal is said to be converted—that is, it then becomes part of the principal, and the increased sum of principal thus obtained forms a new amount upon which interest will be computed for the next period. Thus, if interest money is converted for more than two periods, the resulting total is called the compound amount of the original investment, and the increase in the value of the original investment is called compound interest. The principal is said to accumulate.

A series of equal payments made at regular intervals of time is called an annuity. An annuity in which the first payment is made at the end of the first period of time is called an ordinary annuity. If the payment is made at the beginning of the first period of time it is called an annuity due. It is very important to distinguish between these two types of annuities.

TABLE A. ONE DOLLAR PRINCIPAL

This table gives the sum to which a one-dollar deposit will increase at compound interest over any number of years. This sum is called the accumulation factor or the compound amount of one dollar. If, for instance, it is desired to know what a $1000 deposit made today will be worth at the end of 10 years at 5% compound interest, enter the table at 10 years, go right to the 5% column and find the accumulation factor of 1.629. Since the original amount was $1000 and the 1.629 refers to an original amount of one dollar, the amount sought will be 1000 times this, or $1629.

TABLE B. ONE DOLLAR PER ANNUM

This table gives the sum to which one dollar per annum paid at the beginning of each year will increase at compound interest. If, for instance, you deposit $10 on every January 1 for the next 15 years in a savings bank paying 4% compound interest, how much will you have in the bank at the end of that time? The table gives you the answer at a glance. Enter the first column of years at 15, go right to the 4% column in Table B and read 20.825, which applies to one-dollar deposits. Since you have deposited $10, your bank account is 10 times this, or $208.25.

Table A. One Dollar Principal

The sum to which one dollar principal will increase at compound interest. Called the "Accumulation Factor" or the "Compound Amount of One."

Yrs.	3%	4%	5%	6%
1	1.030	1.040	1.050	1.060
2	1.061	1.082	1.103	1.124
3	1.093	1.125	1.158	1.191
4	1.126	1.170	1.216	1.262
5	1.159	1.217	1.276	1.338
6	1.194	1.265	1.340	1.419
7	1.230	1.316	1.407	1.504
8	1.267	1.369	1.477	1.594
9	1.305	1.423	1.551	1.689
10	1.344	1.480	1.629	1.791
11	1.384	1.539	1.710	1.898
12	1.426	1.601	1.796	2.012
13	1.469	1.665	1.886	2.133
14	1.513	1.732	1.980	2.261
15	1.558	1.801	2.079	2.397
16	1.605	1.873	2.183	2.540
17	1.653	1.948	2.292	2.693
18	1.702	2.026	2.407	2.854
19	1.754	2.107	2.527	3.026
20	1.806	2.191	2.653	3.207
30	2.427	3.243	4.322	5.743
40	3.262	4.801	7.040	10.286
50	4.384	7.107	11.467	18.420
60	5.892	10.520	18.679	32.988

Table B. One Dollar Per Annum

The sum to which one dollar per annum, paid at the beginning of each year, will increase at compound interest.

3%	4%	5%	6%
1.030	1.040	1.050	1.060
2.091	2.122	2.150	2.184
3.184	3.246	3.313	3.375
4.309	4.416	4.526	4.637
5.468	5.633	5.802	5.975
6.662	6.898	7.142	7.394
7.892	8.214	8.549	8.897
9.159	9.583	10.027	10.491
10.464	11.006	11.578	12.181
11.808	12.486	13.207	13.972
13.192	14.026	14.917	15.870
14.618	15.627	16.713	17.882
16.086	17.292	18.599	20.015
17.599	19.024	20.579	22.276
19.157	20.825	22.657	24.673
20.762	22.698	24.840	27.213
22.414	24.645	27.132	29.906
24.117	26.671	29.539	32.760
25.870	28.778	32.066	35.786
27.676	30.969	34.719	38.993
49.003	58.328	69.761	83.802
77.663	98.827	126.840	164.048
116.181	158.774	219.815	307.756
167.945	247.510	371.263	565.116

Table C. Present Value of One Dollar Principal

The present value of one dollar to be received at the end of any number of years. Compound Interest.

3%	4%	5%	6%	Yrs.
0.9709	0.9615	0.9524	0.9434	1
0.9426	0.9246	0.9070	0.8900	2
0.9151	0.8890	0.8638	0.8396	3
0.8885	0.8548	0.8227	0.7921	4
0.8626	0.8219	0.7835	0.7473	5
0.8375	0.7903	0.7462	0.7050	6
0.8131	0.7599	0.7107	0.6651	7
0.7894	0.7307	0.6768	0.6274	8
0.7664	0.7026	0.6446	0.5919	9
0.7441	0.6756	0.6139	0.5584	10
0.7224	0.6496	0.5847	0.5268	11
0.7014	0.6246	0.5568	0.4970	12
0.6810	0.6006	0.5303	0.4688	13
0.6611	0.5775	0.5051	0.4423	14
0.6419	0.5553	0.4810	0.4173	15
0.6232	0.5339	0.4581	0.3936	16
0.6050	0.5134	0.4363	0.3714	17
0.5874	0.4936	0.4155	0.3503	18
0.5703	0.4746	0.3957	0.3305	19
0.5537	0.4564	0.3769	0.3118	20
0.4120	0.3083	0.2314	0.1741	30
0.3066	0.2083	0.1420	0.0972	40
0.2280	0.1407	0.0872	0.0543	50
0.1697	0.0951	0.0535	0.0303	60

TABLE C. PRESENT VALUE OF ONE DOLLAR PRINCIPAL

Suppose that you have agreed, by means of a note, to pay someone $1000 three years from today. Then, through a fortunate series of circumstances, you suddenly obtain a considerable amount of money and desire to scratch off this debt immediately. Naturally there should be some deduction in the amount you pay him, equal to the three years' interest on the money that you could be earning had you delayed payment and put the money in a bank instead. If money is worth 6% compound interest, how much would you have to pay him to clear this debt of $1000 due in three years? Enter the table in the yearly column at 3, go right to 6% and read 0.8396, which applies again only to one dollar. Since your debt amounted to $1000, multiply this by 1000, and get $839.60. This amount with three years' compound interest will equal $1000 and, therefore, represents the amount you should pay now, instead of $1000 three years from now.

TABLE D. PRESENT VALUE OF ONE DOLLAR PER ANNUM

Suppose you have bought a life-insurance policy costing $100 per year. It has 14 years yet to run, and the current rate of interest is 3%. You have inherited some money and you would like to pay all 14 payments immediately. How much would you have to pay in one lump sum? The table, if entered from 14 years and read under the column of 3%, gives the figure 11.296, which when multiplied by $100 gives $1129.60. This amount will completely pay up your 14-year life-insurance premiums, instead of $1400 in yearly payments.

TABLE E. ANNUITY WHOSE ACCUMULATION AT COMPOUND INTEREST IS ONE DOLLAR

Suppose you have a debt of $8000 that you do not have to pay until 8 years from now, and yet you want to set aside a certain amount of money every year in order that you will be ready to make the payment when it comes due. How much money will you have to set aside at 5% compound interest every year to be able to meet this $8000 note 8 years from now? This is called a "sinking fund", and the answer can be found by entering Table E at 8 years and reading under the 5% column the figure 10.47%. Your annual savings, therefore, must be $8000×0.1047=$837.60. Such a deposit made every year, plus interest, will amount to $8000 in 8 years.

TABLE F. ANNUITY WHOSE PRESENT VALUE AT COMPOUND INTEREST IS ONE DOLLAR

Suppose you plan to build a house and want to borrow $9000. How much will you have to pay at the end of each year at 5% compound interest to amortize this loan in 20 years? Table F gives the factor at 20 years of 8.02%, so your yearly payments will be 0.0802×$9000=$721.80.

This table will also answer another question. Suppose your bank account amounts to $14,000, and you know that the interest alone will not be sufficient for your needs. Therefore, you want to draw out not only the interest but some of the principal each year, and yet you want the sum to last at least 12 years. The table, if money is worth 4% compound interest, gives the factor of 10.66%, so the $14,000 plus the interest will last 12 years if you take out 0.1066×$14,000=$1,492.40 every year.

Table D. Present Value of One Dollar Per Annum

The present value of one dollar per annum to be received at the end of any number of years. Compound Interest.

Table E. Annuity Whose Accumulation at Compound Interest Is One Dollar

The annual amount to be paid at the end of each year required to accumulate to one dollar. Called the "Sinking Fund Factor." Values given in per cent.

Table F. Annuity Whose Present Value at Compound Interest Is One Dollar

The annual amount to be paid at the end of each year required to amortize a debt of one dollar. Called the "Amortization Factor." Values given in per cent.

Yrs.	3%	4%	5%	6%	3%	4%	5%	6%	3%	4%	5%	6%	Yrs.
1	0.971	0.962	0.952	0.943	100.00	100.00	100.00	100.00	103.00	104.00	105.00	106.00	1
2	1.913	1.886	1.859	1.833	49.26	49.02	48.78	48.54	52.26	53.02	53.78	54.54	2
3	2.829	2.775	2.723	2.673	32.35	32.03	31.72	31.41	35.35	36.03	36.72	37.41	3
4	3.717	3.630	3.546	3.465	23.90	23.55	23.20	22.86	26.90	27.55	28.20	28.86	4
5	4.580	4.452	4.329	4.212	18.84	18.46	18.10	17.74	21.84	22.46	23.10	23.74	5
6	5.417	5.242	5.076	4.917	15.46	15.08	14.70	14.34	18.46	19.08	19.70	20.34	6
7	6.230	6.002	5.786	5.582	13.05	12.66	12.28	11.91	16.05	16.66	17.28	17.91	7
8	7.020	6.733	6.463	6.210	11.25	10.85	10.47	10.10	14.25	14.85	15.47	16.10	8
9	7.786	7.435	7.108	6.802	9.84	9.45	9.07	8.70	12.84	13.45	14.07	14.70	9
10	8.530	8.111	7.722	7.360	8.72	8.33	7.95	7.59	11.72	12.33	12.95	13.59	10
11	9.253	8.760	8.306	7.887	7.81	7.41	7.04	6.68	10.81	11.41	12.04	12.68	11
12	9.954	9.385	8.863	8.384	7.05	6.66	6.28	5.93	10.05	10.66	11.28	11.93	12
13	10.635	9.986	9.394	8.853	6.40	6.01	5.65	5.30	9.40	10.01	10.65	11.30	13
14	11.296	10.563	9.899	9.295	5.85	5.47	5.10	4.76	8.85	9.47	10.10	10.76	14
15	11.938	11.118	10.380	9.712	5.38	4.99	4.63	4.30	8.38	8.99	9.63	10.30	15
16	12.561	11.652	10.838	10.106	4.96	4.58	4.23	3.90	7.96	8.58	9.23	9.90	16
17	13.166	12.166	11.274	10.477	4.60	4.22	3.87	3.54	7.60	8.22	8.87	9.54	17
18	13.754	12.659	11.690	10.828	4.27	3.90	3.55	3.24	7.27	7.90	8.55	9.24	18
19	14.324	13.134	12.085	11.158	3.98	3.61	3.27	2.96	6.98	7.61	8.27	8.96	19
20	14.877	13.590	12.462	11.470	3.72	3.36	3.02	2.72	6.72	7.36	8.02	8.72	20
30	19.600	17.292	15.372	13.765	2.10	1.78	1.51	1.26	5.10	5.78	6.51	7.26	30
40	23.115	19.793	17.159	15.046	1.33	1.05	0.83	0.65	4.33	5.05	5.83	6.65	40
50	25.730	21.483	18.256	15.762	0.89	0.66	0.48	0.34	3.89	4.66	5.48	6.34	50
60	27.676	22.623	18.929	16.161	0.61	0.42	0.28	0.19	3.61	4.42	5.28	6.19	60

SOUND HOME OWNERSHIP Means Financial Independence

● A HOME owned free and clear is a blessing and a safeguard against many unpleasant experiences. If you own your own home and employment ceases, you have a place to live and can curtail your expenses at will. If the house is so designed that you have an extra room and an extra bath to rent out, the income thus created will enable you to take care of the necessities until you will be able to manage without this means of income. This is possible with the "House of Health" because the upkeep of the "House of Health" is low.

THE CARRYING CHARGES FOR THE "HOUSE OF HEALTH" FOR THE FIRST 20 YEARS

Let us assume that your house cost $8000 to build. You have paid down $1600 and have taken a $6400 mortgage at 5% for 20 years. Table F shows that for such a loan the amortization factor is 8.02%, which represents the interest charge on the mortgage at 5%, plus 3.02% to pay off this amount in 20 years. Thus, the carrying charges for the first 20 years on the "House of Health" are as follows:

For the First Twenty Years

Loan, 8.02% of 80%	6.42	
Tax, 2½% of 80%	2.00	
Maintenance and Depreciation	1.00	
Fuel	1.00	10.42%
Less amount saved by reducing mortgage debt		
Sinking Fund Factor 3.02% of 80%		2.42%
Total Cost Per Year		8.00%

It will be seen that the actual yearly charges are 10.42% of $8000=$833.60. However, 2.42% of $8000=$193.60, which is actually the saving that you are making by reducing the mortgage debt. Therefore, this 2.42% may be deducted, leaving an expense of only 8% of $8000, or $640.00 per year.

CARRYING CHARGES AFTER THE FIRST 20 YEARS

After the First Twenty Years

Tax, 2½% of 80%	2.00
Maintenance and Depreciation	1.00
Fuel	1.00
Total Cost Per Year	4.00%

Now the annual expenses are only 4%, or $320, because of the elimination of the mortgage cost of the 2.42% payment during the first 20 years.

THE ACTUAL PRICE OF HIGHER LIVING COSTS

For an ordinary house the items of maintenance and depreciation should be figured as 5%, and fuel 1.5%, and the house itself will cost 10% less than the "House of Health", or $7200. Thus when these higher percentage figures are placed in the above tables it is found that the actual expense of living in this ordinary house is 12.5% of $7200=$900 per year. The difference between this $900 and $640 for the "House of Health" equals $260 per year. This $260, if deposited every year at 5% compound interest, will in 20 years, as shown in Table B, amount to $9027.

This means that by living in the higher-priced "House of Health" you have decreased your living expenses by approximately 4%, or $260 a year, which by investing you have built up to over $9000, plus a "House of Health" that is all paid for.

Since the ordinary house costs $800 less than the "House of Health", allowances must be made for this. $800 over the period of 20 years considered, if deposited at 5% interest, will increase in value to $2122. (See Table A.) Therefore, the savings of $9027, shown above from operating expense alone, must be reduced by $2122=$6905, which represents the actual saving in building and living in the "House of Health" over the ordinary house.

"HOUSES OF HEALTH" TO BE BUILT FOR TENANTS

If you have no money how can you own a "House of Health"? It is, in a manner, possible—if you have a steady income and are found to be a good risk. You can, for instance, select an $8000 house and sign a 5-year lease as a tenant, with an option to buy the house after this time for $6400. Usually a prospective houseowner must have 20% cash on the purchase price, or $1600 in this case, to have his house built. During the 5-year term of the lease you must pay up this $1600 that you should have had in the beginning, at an assumed rate of 6%, by five annual payments of 23.74% of $1600=$379.

THE CARRYING CHARGES FOR THE FIRST FIVE YEARS WILL BE

Tenant Loan 23.74% of 20%	4.75	
Loan, 8.02% of 80%	6.42	
Tax, 2½% of 80%	2.00	
Maintenance and Depreciation	1.00	
Fuel	1.00	15.17%
Deduct for Savings (Sinking Fund Factor)		
On Tenant Loan, 17.74% of 20%	3.55	
On Loan, 3.02% of 80%	2.42	5.97%
Total Cost Per Year		9.20%

Thus it is seen that the nominal yearly charges will be 15.17% of $8000=$1213.60, but since, as is shown, there is actually included in this a saving of 5.97% of $8000=$477.60, the actual expenses are only 9.20% of $8000=$736. This compares very favorably with the yearly living expenses of $900 for the ordinary house.

HEATING MANUAL

HEAT KNOWLEDGE

● HEAT PASSES readily and rapidly from a warmer element to a cooler element. It has the property of passing directly through every known material, although the rate of travel through some is less rapid than through others. Heat will not pass through a complete vacuum.

Heat Conductors are materials through which heat travels rapidly. All commonly used building materials—metal, concrete, stone, brick, hollow tile, stucco, plaster, lumber, etc., are heat conductors, since, in the thicknesses used, the heat flow through them is rapid.

Heat Insulators are materials through which the transfer of heat is very slow.

The action of the heat. Loss of heat occurs through the heat flow from a substance of high temperature to one of lower temperature. Therefore, heat enclosed in a house will reach or enter the inside surface of the wall by radiation (wave motion) and by convection (heat moved by circulation of the air). The air within the house is always warmer than the inside surface of the wall. This heat must pass through the material of the wall from the inside to the outside by conduction and is finally given off from the outside surface by radiation and convection.

Intensity of heat is measured in terms of degrees Fahrenheit, the freezing point of water being 32 degrees and the boiling point 212 degrees.

Quantity of heat is measured by British thermal units (Btu) and one Btu is that quantity of heat which will raise the temperature of one pound of water one degree Fahrenheit.

Heat Transfer. There are three ways by which heat is transferred:

a. Radiation. Heat travels in direct rays from a source much the same way as light does. Study the heat and the light from the sun. In the shadow the heat as well as the light is decreased in intensity.

b. Convection. Heat transfer by convection depends on the circulation of a fluid or the air. A transfer is accomplished by the motion of the fluid from a locality where it receives heat to a locality where it gives up heat.

c. Conduction. If one end of an iron rod is heated, the heat will gradually reach the other end, but not until the whole length of the rod is heated. Some materials conduct heat better than others. Materials which are extrapoor conductors—for instance, asbestos and Rock Wool—are used for insulation.

Radiation. Radiators for steam and hot-water systems are rated in square feet by the amount of heat they are capable of giving off.

One square foot of radiation is equal to an emission of 240 Btu per hour when the radiator is filled with steam under perfect conditions.

One square foot of radiation gives off 150 Btu per hour when a radiator is used in a hot-water system at a mean temperature of 170 degrees.

GENERAL THEORIES OF CONDENSATION AND COMBUSTION

The amount of heat required to change a pound of water into a pound of steam is approximately 1,000 Btu. The necessity of this large amount of heat is due to the fact that, besides raising the temperature of the water, a change of state—from liquid to a gas—must take place.

Condensation. This steam, circulating through pipes and radiators, in condensing back to a liquid will give up approximately 1,000 Btu that will be utilized in heating the building. This is the reason why condensation must take place in a radiator in order to get the full heating efficiency.

It is not the steam itself in a radiator which gives up much heat, but the heat developed in the change back from gas to liquid.

One square foot of radiation at 2 pounds pressure is expected to emit 240 Btu. This is about one quarter of the Btu required to evaporate one pound of water.

Combustion. The heat developed in order to produce steam is usually obtained from the combustion of coal or oil or illuminating gas.

Coal, containing principally carbon and hydrogen, when burning, gives off heat with the formation of carbon dioxide or carbon monoxide.

The average coal, when turned into a gas by the introduction of sufficient oxygen, will produce approximately 12,000 Btu per pound. To accomplish this, air must be introduced into the flues to give complete combustion and a certain dilution. For this process 250 cubic feet of air are required per each pound of coal to be combusted.

If, for instance, 10 pounds of coal are properly burned, there will be realized 120,000 Btu, and if the overall efficiency of the boiler is 60%, the obtained radiation will be

$$\frac{120{,}000}{240} \times 0.6 = 300 \text{ square feet.}$$

Oil has in the last few years taken its place as a fuel of major importance for heating systems. Fuel oils—defined as any liquid or liquefiable petroleum product burned for the generation of heat—are identified by numbers from 1 to 6. The oils having the higher identifying numbers have a higher heat value, are less volatile, heavier, more viscous, contain more solid matter and water, and cost less per gallon. The first three grades were originally adapted to domestic use, but there is a trend today to lower grades of oil. The main reason is that the lighter oil contains less heating value per gallon than the heavier oil.

Gas as a fuel for house heating is rapidly increasing. It is broadly classified as being either natural or manufactured. Natural gas is a mechanical mixture of several combustible and inert gases rather than a chemical compound. Manufactured gas, as distributed, is usually a combination of certain proportions of gases produced by two or more processes and is often designated as city gas.

The Chimney. Therefore, in order to burn coal, oil or gas, large quantities of air are required, the oxygen of which combines with the carbon and the hydrogen to generate heat.

In order to obtain this large quantity of air, a pressure must be created from the fire out through the chimney. This pressure depends on the difference in weight between the column of air in the chimney and a similar column of air of the outside temperature. Therefore, it is essential to have a relatively high stack temperature. Heated air expands and gets lighter than cold air. The difference in weight creates the air motion, popularly called draft.

TEMPERATURES OF DIFFERENT SYSTEMS

Certain thermal states or "temperatures" may be reproduced or recognized by the fact that definite phenomena occur at these temperatures. Those thermal states are called "fixed points", and are the "ice point" and the "steam point."

The ice point is defined as the temperature of melting ice, and the steam point is defined as the temperature of condensing water vapor at standard atmospheric pressure.

There are three widely known systems of measuring temperatures.

The Centigrade Scale is subdivided into a hundred degrees of the temperature interval between the ice point (temperature of ice point given as zero) and the steam point (temperature of steam point given as 100). This system was first used by Celsius, a German, so therefore the temperature is given as "C" and is read "degree Celsius." Used in the Scandinavian countries, Germany and Austria.

The Reaumur Scale subdivides the temperature interval between the ice point (temperature of ice point given as zero) and the steam point (temperature of steam point given as 80) into 80 parts, one part of which is chosen as the unit of temperature and named "degree Reaumur." It is given as "deg. R." Used in France and Russia.

The Fahrenheit Scale subdivides the temperature interval between the ice point (temperature of ice point given as 32 deg. F.) and the steam point (temperature of steam point given as 212 deg. F.) into 180 parts, one part of which is chosen as the unit of temperature and is named "degree Fahrenheit." It is given as "deg. F." Used in countries where English is spoken.

Temperatures by Fahrenheit, Celsius and Reaumur compared.

Fahrenheit	*Celsius*	*Reaumur*	*Fahrenheit*	*Celsius*	*Reaumur*
—40	—40.0	—32.0	+ 64	+ 17.8	+14.2
—20	—28.9	—23.1	+ 66	+ 18.9	+15.1
0	—17.8	—14.2	+ 68	+ 20.0	+16.0
+10	—12.2	— 9.8	+ 70	+ 21.1	+16.9
+20	— 6.7	— 5.3	+ 72	+ 22.2	+17.8
+30	— 1.1	— 0.9	+ 74	+ 23.3	+18.7
+32	0.0	0.0	+ 76	+ 24.4	+19.6
+40	+ 4.4	+ 3.6	+ 78	+ 25.6	+20.4
+50	+10.0	+ 8.0	+ 80	+ 26.7	+21.3
+60	+15.6	+12.4	+100	+ 37.7	+30.2
+62	+16.7	+13.3	+212	+100.0	+80.0

Note: It might be interesting to know that the average room temperature in the Scandinavian countries is +17 degrees Celsius, or only 62.6 degrees Fahrenheit, considerably lower than the average temperature of 68 deg. F., used in the U.S.A.

THE UNDERLYING THEORY FOR HEAT TRANSMISSION

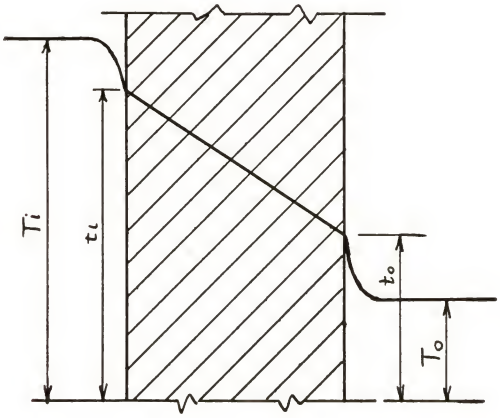
Let us consider a solid wall, with one side in contact with warm air (inside), and the other side in contact with cold air (outside).

The amount of heat transmitted from the inside to the outside through the wall will depend upon three factors:

1. The heat transmission from the warm air (inside) to the inside surface of the wall. It depends upon the surface coefficient f_i.
2. The heat transmission through the wall from the warm inside surface to the cold outside. It depends upon the transmission coefficient k and the thickness.
3. The heat transmission from the outside surface of the wall to the colder air. It depends upon the surface coefficient f_o.

The values of f_i and f_o depend to a large extent upon the movement of the air at the surfaces. If the air moves fast, more heat is transmitted than if the air moves slowly. Therefore, a building exposed to the winds will release more heat and, consequently, require more heating than a building protected from the winds.

The resistance of still and moving air has been determined through experiments and has been found to be more or less constant for all commonly used building materials. For values to use, see table for "Conductivity and Resistivity of Building Materials."



The heat transmission through the wall itself is in reverse ratio of the thickness. Thus a material 2 inches thick will transmit twice as much heat as 4 inches of the same material.

If a wall of homogeneous material separating an inside temperature of T_i from an outside temperature of T_o is let alone, a balanced condition will occur as shown in the figure.

The heavy line represents graphically the temperature in every point of the wall from the inside air to the outside air. The temperature t_i at the inside surface of the wall will be somewhat lower than the room temperature T_i, and the temperature at the outside surface of the wall t_o will be somewhat higher than the outside air temperature T_o.

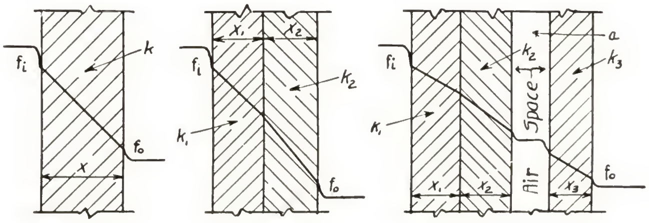
Note: The molecules in a body are always moving. The higher the temperature, the higher the speed of the molecules. By collisions the faster-moving molecules are slowed down somewhat, while the slower-moving molecules gain more speed.

COEFFICENTS OF TRANSMISSION—U

The coefficients of transmission for a wall, roof or floor construction are the amount of heat expressed in Btu transmitted in one hour, per square foot and per degree Fahrenheit difference in temperature. The commonly used symbol is "U." This constant is also called "overall coefficient of heat transfer."

The coefficients of transfer may be determined experimentally (by means of the guarded heat box or the Nicholls heat meter), or they may be calculated from the fundamental thermal conductivities.

The method for the theoretical computing of the overall coefficients U of heat transfer was first set forth by Rietschel and is the one used by leading authorities today.



For a simple wall of one material $U = \dfrac{}{\dfrac{1}{f_i} + \dfrac{x}{k} + \dfrac{1}{f_o}}$

For a composite wall, having no airspace $U = \dfrac{1}{\dfrac{1}{f_i} + \dfrac{x_1}{k_1} + \dfrac{x_2}{k_2} + \dfrac{1}{f_o}}$

For a composite wall, with air space $U = \dfrac{1}{\dfrac{1}{f_i} + \dfrac{x_1}{k_1} + \dfrac{x_2}{k_2} + \dfrac{1}{a} + \dfrac{x_3}{k_3} + \dfrac{1}{f_o}}$

U=Btu transmitted per hour, per square foot, per degree difference in air temperature on either side of the section.

f_i=surface coefficient with still air (inside). The range of values for ordinary building materials is comparatively small and for practical purposes may be assumed constant. (Also applies to moving air.)

f_o=surface coefficient with moving air. It is customary to use that value of f_o which will occur when a 15-mph wind blows parallel to the outer surface considered.

a=the conductance of an airspace.

k_1,k_2,k_3=conductivities of the respective materials in the section per inch of thickness, per square foot, per hour, per degree difference in surface temperatures.

x_1,x_2,x_3=thickness in inches of the respective materials in section.

Illustrative problem: Calculate the transmission coefficient (U) of a frame wall with wood siding, building paper and sheathing, 4 inch studs, metal lath and plaster.

Going from the inside outwards, we have:

f_i (ordinary, still air) conductance		$=1.65$
metal lath and plaster,	"	$=4.40$
airspace between studs,	"	$=1.10$
sheathing, paper and siding	"	$=0.50$
f_o (air in motion)	"	$=6.00$

so we get:

$$U = \frac{1}{\frac{1}{1.65}+\frac{1}{4.40}+\frac{1}{1.10}+\frac{1}{0.50}+\frac{1}{6.00}} = \frac{1}{3.91}$$

$$U=0.256$$

COEFFICIENTS OF RESISTANCE—R

Instead of using the Rietschel formulas in order to find the transmission coefficient U, here a much simpler method is shown, by which the "resistance to heat flow" is used. By this method complicated fractional equations are eliminated and a simple formula with only additions is required.

The internal "resistance to heat flow" R_1, R_2, etc., of any material is the reciprocal of its conductance. Thus:

$$R_1 = \frac{1}{\text{conductance}}$$

If we, for instance, consider an 8-inch hollow tile wall, we find the conductance to be 0.60.

Hence, the internal resistance will be:

$$R_1 = \frac{1}{0.6} = 1.67$$

For a unit thickness of a homogeneous material we have the expression "resistivity" marked "r"—that is, the reciprocal of conductivity. Thus:

$$r = \frac{1}{\text{conductivity}}$$

If we, for instance, consider Rock Wool, we find the conductivity $k=0.27$, and, therefore, the internal resistivity:

$$r = \frac{1}{0.27} = 3.7$$

Rule. The Resistance (R_1) equals the resistivity (r) times the thickness (x) of the material. Hence:

$$R_1 = r\,x$$

If we, for instance, consider 4 inches of Rock Wool ($r=3.7$), we get the internal resistance:

$$R_1 = 4 \times 3.7 = 14.8$$

The air-to-air resistance (R) is the reciprocal of the heat transmission coefficient (U). Hence:

$$R = \frac{1}{U}$$

Rule. TO FIGURE THE AIR-TO-AIR RESISTANCE (R), JUST ADD UP THE INTERNAL RESISTANCES (R_1, R_2, etc.)

Formulas for the overall resistance R

Single wall of one material.

$$R = r_i + R_1 + r_o$$

Composite wall, having no internal airspace.

$$R = r_i + R_1 + R_2 + r_o$$

Composite wall with one internal airspace.

$$R = r_i + R_1 + R_2 + r_a + R_3 + r_o$$

R=the overall resistance. The higher this value is, the greater the insulating property. Represents the degree difference in temperature on opposite sides of a body, which will cause one Btu to pass through an area of one square foot of this body in one hour.

r_i=surface resistance of still air (inside). ($r_i=0.67$).

r_o=surface resistance of moving air (outside). ($r_o=0.17$).

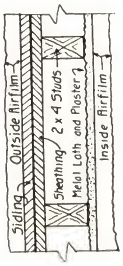
R_1, R_2, etc.=total internal resistance of each material.

r_a=still-air space resistance. If a space is wider than ¾ inch, $r_o=r_i$. ($r_a=0.91$).

Note: The heat resistance of the thin film of air immediately surrounding the exposed surface is important. The resistance afforded by such thin air film is known as "surface resistance." When the air is disturbed, as by wind, the surface air film becomes thinner and, consequently, offers less resistance to the escape or entrance of heat by conduction. Therefore, two surface resistances are given, one for still air, such as inside a building (r_i), and the others for conditions were the air is in rapid motion, as represented by a wind velocity of 15 mph, such as outside a building (r_o). (Recommended values given above.)

Illustrative problem: Calculate the air-to-air (overall) resistance of a frame wall with siding, building paper and sheathing, 4 inch studs, and metal lath and plaster.

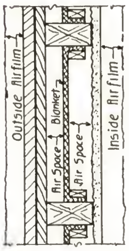
With reference to the table on "Conductivity and Resistivity of Building Materials", where the resistances can be picked direct for each item, we get, by going from the inside out:



Inside surface resistance	0.61
Metal lath and plaster	0.23
Airspace resistance	0.91
Sheathing, bldg. paper & siding	2.00
Outside surface resistance	0.17
Air-to-air R=3.92	

The same problem has been figured before with the use of the transmission formula. We got $U=0.256$. It will be found that $1/U=3.92$.

If flexible insulation ½ inch thick is placed between the studs, it will easily be seen that another airspace is obtained. We get:



Wall without insulation	3.92
(See above example)	
One additional airspace	0.91
½ in. Balsam Wool, R=½×3.7	1.85
Air-to-air R=6.68	

Through the insulation the resistance has been made 47% greater.

THE BASE COST IN HEATING

How much will it cost to heat my house is often your first question, and then the sales engineer promptly begins talking about the cost of Btu. He refers to a unit cost which is the basic element in the total expense, but it is only one of many elements, and, in the material which follows, this point must not be lost sight of, or else a very misleading answer will be derived.

All heat can be measured in terms of Btu, and sometimes it is useful to know how to use this symbol, which simply stands for the amount of heat needed to raise the temperature of a pound of water just one degree, the initials representing British thermal units.

Now, in spite of the big differences in their outward forms, science has given us an accurate measure of the heating power of all fuels expressed in terms of Btu. In the table on the following page, typical unit figures are given, but, of course, fuels do vary in quality, and therefore the values in the table should be accepted as illustrative of the type mentioned.

THE COST DEPENDS ON MANY FACTORS

This table gives the theoretical values or potential heat energy. In practice, the results obtained depend upon the skill of the installer and designer of the equipment; on the fireman and the firing conditions—such as draft, size of heating equipment in relation to the house, and season of the year; and, above all, on the so-called plus charges. This table deals only with fuel, but the homeowner must consider the equipment and its cost, the power cost for operating mechanical units, and a proper charge for the maintenance of automatic devices in first-class operating shape. After all these charges have been considered, there is another factor to weigh, and in the case of automatic heating devices it is usually first in importance. What is the reliability and assurance that you will get quick service from the company who sold the equipment when a service emergency occurs? And what will they charge for such service over a period of several years?

HOW THE COST OF HEAT IS DETERMINED

The following table shows the cost of the fuel as it is received and as it is usefully applied. The considerable difference between them is due to the efficiencies of typical equipment and takes into account some of the losses occurring between the time the fuel is delivered and when it is developed into useful heat. The typical values assumed in the table are those generally used by the American Society of Heating and Ventilating Engineers, but in actual cases both lower and more rarely higher efficiency could be secured. A typical formula for determining the cost in dollars of 1,000,000 Btu of useful heat under your conditions is as follows:

$$\begin{array}{l}\text{Base Cost of Useful Btu}\\ \text{in Dollars per Million}\end{array} = \frac{1{,}000{,}000\times\text{Unit Cost as Received}}{\text{Overall Efficiency}\times\text{Btu as Received}}$$

Values for the constants can be proved in the table.
Example: The cost of 1,000,000 Btu is wanted in an oil-burning heating plant. The price of the oil is 5½¢ per gallon, and the efficiency has been proved to be 70%. We get the cost to be

$$\frac{1{,}000{,}000\times 0.055}{0.70\times 140{,}000} = \$0.56$$

COAL

Unit of sale is a ton of 2,000 pounds but quality varies. Physical appearance, size, and burning properties are different. Coal contains moisture and ash which must be paid for but do not contribute to useful heat.

The ash must be removed and collected, and the amount will vary from 100 to 400 pounds per ton of coal burned.

Clinkers result from melting together of ash, and, consequently, their formation depends on the melting temperature of ash and the rate of firing. Excessively hot fires, garbage burning in the fire pot, and banking with ashes are contributory causes to clinker formation.

Best size coal for a given furnace and home can be found by trial but larger uniform sizes are generally best; certainly to be preferred over mixed sizes. However, small-size coal kept separately is sometimes used for banking.

Types of Coals. Coaldealers can furnish the analysis of the coal purchased, showing the percentage by weight of fixed carbon, volatile matter, moisture and ash and also the heating value. Of these, the first two—fixed carbon and volatile matter—are the combustibles in the coal, the amount of the latter being an index of the smoke-producing tendency.

Anthracite coals have a fuel ratio $\left\{\frac{\text{fixed carbon}}{\text{volatile matter}}\right\}$ equal to 10 or more and, therefore, burn with short flames, almost without smoke. They do not soften or swell.

Semibituminous coals are low in moisture, ash and sulphur and have a high heating value. Fuel ratios are between 3 and 6. These coals may break into small sizes through rough handling and may form a layer of fused coal over the top of the firebed. Producing more smoke than anthracites, they are, nevertheless, satisfactory coals.

Bituminous, or soft, coals, with fuel ratios under 3, are smoky fuels, and each of the many varieties available requires a different treatment for successful use. High in volatile matter, they fire quickly during the time that the gases are coming off and then slowly for a long time afterward.

Coke is made from coal by heating to remove most of the volatile matter and moisture. Therefore, it is a smokeless fuel, cleaner in handling and firing than the coals from which it is produced. The simple knack of proper arrangement of dampers and deep firebeds can easily be acquired, making coke one of the best solid fuels.

OIL

Unit of sale is the gallon, although amount of heat purchased on the basis varies slightly with the grade of oil and its source. Oils are numbered 1, 2, 3, 4, etc., but for the average home no oil burner for heavier oil than Number 3 is listed by the National Board of Fire Underwriters. Numbers 1 and 2 are most frequently used in vaporizing-type burners and combination atomizing and vaporizing types. The retort-type and vertical rotary blue-flame burners use Number 2 oil. The gun or pressure atomizing types use Number 3 oil.

GAS

The unit is generally 1000 cubic feet, although some gas companies sell gas by what is known as the therm, or 100,000 Btu. Several kinds of gas are available in the United States. Along the Eastern seaboard, the typical gas is manufactured from coal and contains between 500–550,000 Btu per MCF. Through the Southwest and in many places through the Middlewest, as well as along the Pacific Coast region, natural gas is the more usual type. This contains from 950,000–1,200,000 Btu in each thousand cubic feet. Natural gas is nature's most ideal fuel. Without processing or purification, natural gas has provided a gas of high heating value and perfect burning characteristics. Man has skillfully contrived to pipe it long distances, and thus thousands of homeowners can enjoy the benefits of this fuel, which are as satisfactory as the cost.

Other areas mix varying proportions of these two gases, while in some communities by-products derived from natural gas operations are liquefied and later used to make gas. These are, also, the basis of the bottled gases which are available in many rural communities.

The cost of gas heating is difficult to summarize in a few words, because the prices charged for gas by the various companies differ very widely. The last few years have seen new prices established for gas for house-heating purposes, making it possible for increased use of gas for house heating even where only manufactured gas is available. Speaking in very broad terms, natural gas is a low-cost, automatic-heating fuel, while manufactured gas is relatively expensive. However, there are many homes in which it can be used to advantage, and you can always secure a reliable estimate on the probable cost of heating your home with gas from your local gas company. By reason of the way in which gas burns, equipment can be made very compact and thus take up less space than other forms of heating apparatus.

Gas equipment for individual-room heating or space heating is widely used in some territories. Such space-heating equipment should be vented, however. Fireplace heaters, circulators, and gas-fired steam radiators are available for auxiliary heating purposes. In some of the milder climates, as in the Southwest and on the West Coast, these units may provide sufficient heat to take care of the entire house.

ELECTRICITY

Electricity is sold by the kilowatt-hour, which can do the same heating as 3,412 Btu. Obviously, it is the most expensive form of heat and is not yet suited for central heating purposes for this reason. Because of the high efficiency with which electric heat can be applied, it is suitable for auxiliary heating equipment, and many a home can use the cheerful bathroom heaters or other space heaters to take the chill off the room on cool mornings.

THE COST OF HEAT

Fuel	*Unit*	*Btu as Received*	*Unit Cost as Received*	*Percentage of Purchased Heat Actually Useful*	*Base Cost of Useful Btu in Dollars per Million*
Anthracite	1 Ton		Per Ton $10–$14	50%–60%	
Egg	" "	26,200,000	" "	Lower efficiency more likely in small sizes. Efficiency lower in mild weather. Results generally variable, dependent on fireman and firing conditions.	.63–1.07
Stove	" "	26,080,000	" "		.63–1.07
Chestnut	" "	25,800,000	" "		.65–1.09
Pea	" "	24,940,000	" "		.67–1.12
Buckwheat	" "	24,860,000	" "		.67–1.13
Bituminous	1 Ton	24–28,000,000	$6.00–$9.00	Smoke elimination a problem.	.36–.75
Coke	1 Ton	25,000,000	$10–$14	50%–60%	.65–1.09
Natural Gas	1,000 cu. ft.	950,000–1,200,000	(Varies with locality from ¼ to ¾ cost of manufactured gas.)	70%–80%	.15–.90
Mixed Gas	1,000 cu. ft.	600,000–950,000		70%–80%	
Manufactured Gas	1,000 cu. ft.	500,000–570,000	55¢–65¢ per MCF	70%–80%	1.21–1.86
Oil	1 gal.	140,000	5½¢–7½¢ per gal.	55%–70%	.56–.97
Electricity	kw-h	3,415	7¢–1¢ per kw-h	90%–95%	3.08–22.80

REDUCING FUEL COSTS THROUGH INSULATION

Frequently an uninsulated house, as far as heat is concerned, is greatly like a sieve. Heat freely flows out through its walls, ceilings and roofs. Cold drafts sift in. You pay for heat that you do not get.

Insulation. Economy and comfort are the outstanding reasons for installing insulation in a home. It prevents heat from going out in winter. It thus saves fuel bills. It prevents heat from coming in in summer. This means comfort. But this comfort is extended over the heating season, too, because it is easier to keep a uniform temperature.

Since insulation enhances the comfort and the desirability of a house, it naturally follows that well-insulated homes should represent greater loan and resale values.

The cost of insulation is but a small proportion of the total cost of the house, and the resulting additional comfort and fuel saving are considerable.

Storm Windows and Storm Doors. The heat losses through windows and doors amount to a little over 50% of the total heat losses. Therefore, storm windows and storm doors, if installed right, prove to be a good investment. It is important that the storm sash is tight fitting.

The storm sash will also eliminate soot and dirt from coming in through the cracks, will minimize condensation on the glass panels, and will prevent cold drafts that often occur near single windows.

Weather stripping. By this method leakage of cold air through cracks around windows is reduced. Metal weather stripping, expertly fitted, does the work most thoroughly, but even the cheapest fabric type tacked on by an amateur will be valuable.

How the Heat Losses Occur. Mr. S. Konzo reports in "Factors Affecting Fuel Savings" (paper presented at the First Annual Conference on Air Conditioning, May 4 and 5, 1936) that the heat losses from a typical uninsulated home, representing an average of 200 existing houses, were distributed as follows:

Heat losses through the roof	16.2%
Heat losses through the walls	27.0%
Heat losses through the glass	25.8%
Heat losses through infiltrations from windows and doors	28.9%
Heat losses from other sources	2.1%

The Fuel Savings. Calculated possible fuel savings from this average house which might be expected by the use of insulation, storm windows and doors, and weather stripping, are listed in the following table:

Calculated Possible Fuel Savings in an Average Home for Various Types of Insulation

Case	*Insulation*		*Weather Stripping*	*Storm Sash*	*Reduction in Fuel Bill in per cent.*
	Wall	*Ceiling*			
a	None	None	None	None	.0
b	1–in.	None	None	None	12.8
c	2–in.	None	None	None	17.4
d	3–in.	None	None	None	19.7
e	3⅝–in.	None	None	None	20.3
f	None	1–in.	None	None	11.3
g	None	2–in.	None	None	13.3
h	None	3–in.	None	None	14.1
i	None	3⅝–in.	None	None	14.5
j	3⅝–in.	3⅝–in.	None	None	34.8
k	None	None	Yes	None	9.8
l	None	None	None	Yes	31.3
m	3⅝–in.	3⅝–in.	None	Yes	66.1

The values given in the table should be regarded as maximum savings to be obtained under ideal conditions in the assumed house. They cannot be applied exactly to any other house. Savings obtained under actual conditions are often less than the values calculated for coldest weather conditions.

The fuel savings do not include such added benefits obtained by the use of insulation as the reduction of drafts, increased temperatures near the floor, and a general increase in the comfort of the occupants. Reduced house temperature during the summer is another benefit of insulation not reflected in the fuel saving.

THE ECONOMY OF INSULATION

It is important to bear in mind that the insulation investment shall be made in such a way as to pay a maximum return. It must be remembered that the use of insulation in increasing thicknesses follows the law of diminishing returns. That is, doubling the thickness of insulation does not double the comfort and fuel saving.

In determining the proper insulation thickness, each house, therefore, represents a problem of its own. The location of the house, the number of degree days to meet, the type and quality of the house construction, the effectiveness of the insulating material, the fuel used and the heating equipment, etc., all have a direct bearing on the result.

The Seasonal Unit Heat Loss. Let us consider a wall, 1 foot square, with an overall transmission coefficient (U). The amount of heat that passes through this wall during a period of (Z) hours when a temperature difference of (T) deg. F. exists between the inside and outside air, is:

$$W=ZTU$$

The product ZT depends on the climatic conditions and the desired room temperature, and if the whole season is considered, this product represents the yearly requirements of heat in degree hours. By multiplying existing degree days by 24, this product is obtained.

The following table will give values of degree days and degree hours for some important cities in the United States:

Degree Days and Degree Hours for Some Important Cities

City	*Degree Days*	*Degree Hours*
New York	5,348	128,000
Boston	6,145	147,500
Chicago	6,315	151,500
Trenton	4,934	118,000

Insulation Investments Analyzed. For an ordinary frame-wall construction without insulation ($U=0.255$) we can determine the heat flow per square foot for one year. If New York is considered, we find the heat flow or the heat loss to be:

$$W=128,000\times0.255=32,700 \text{ Btu.}$$

By assuming a cost of 65¢ for one million Btu, the cost of the lost heat will be 0.032,700×65=2.13¢.

If the cost of the wall is assumed to be 32¢ per square foot, the interest rate is 6% and the depreciation is 3%, we get:

Total yearly cost

Wall 32×0.09=	2.88
Heat loss per square foot	2.13
Total Cost	5.01¢ per square foot

By inserting ½ inch blanket insulation between the studs, with the transmission coefficient $U=0.15$, the heat flow will be:

$$W=128,000\times0.15=19,150 \text{ Btu.}$$

The cost of the ½ inch insulation blanket installed is 6¢; we get:

Total yearly cost for frame wall with ½-inch insulation

Wall 32×0.09=	2.88
Insulation 6×0.09=	0.54
Heat 0.019,150×65=	1.25
Total Cost=	4.67¢ per square foot

By inserting 1-inch blanket insulation, installed at 10¢ per square foot, we get for a heat loss of 15,000 Btu.:

Total yearly cost for frame wall with 1-inch insulation

Wall 32×0.09=	2.88
Insulation 10×0.09=	0.09
Heat 0.01500×65=	0.98
Total Cost=	4.76¢ per square foot

If fuel economy is the principal consideration, it is apparent that it is advisable to use the ½ inch insulation, as the cash outlay will be less for this type. If, however, comfort is the prime deciding factor, then use a thickness sufficient to give maximum protection both in winter and in summer.

The wall construction plays an important part in this analysis. We assumed a depreciation of 3%. On certain types of walls—such as brick—it might be possible to cut this figure to 2% or even 1%. As the insulation will stay as long as the wall stays, it can easily be seen that for a high-type wall construction with a lower depreciation coefficient it will be economical to increase the insulation investment.

HEAT LOSSES FROM BUILDINGS

When the interior of a building is maintained at a temperature higher than that of the outside air, there is a continuous flow of heat from the building, and it is the function of the heating system to supply sufficient heat to maintain the desired temperature.

The calculation of the heat loss from each room in the building is of basic importance in heating-system design, because it is used to determine the radiator sizes, which, in turn, fix the pipe sizes and the size of the boiler.

Heat Losses through Transmission. The heat losses occur in different ways. The greatest loss is through walls and window glass. The heat flows through these materials at varying rates, depending upon the coefficient of transmission (U), which, when multiplied by the area and the temperature difference, gives the number of heat units lost each hour. This is termed "losses through transmission."

To estimate the hourly heat loss through transmission for any particular kind of building construction, the following formula is used:

$$H=U\times A\times T$$

H=Btu per hour transmitted through the material of the wall, glass, roof or floor.

U=heat transmission coefficient to be found in the tables.

A=area in square feet of wall, glass, roof or floor. Use the net inside surface dimensions in all cases.

T=temperature difference between outside and inside air.

Example: What is the hourly heat loss through the outside wall of a room 12 feet long and 9 feet high? The wall is frame construction, with clapboards on wood sheathing with building paper, studding and ¾ inch plaster on metal lath.

This construction corresponds to Basic Case I, with $U=0.255$.

If the difference in temperature is assumed to be 70 degrees, we get the hourly heat loss:

$$H=0.255\times108\times70=1,930 \text{ Btu.}$$

This is for a solid wall. If there is a window, 3′×4′, the 12 square feet of window area will have to be deducted from the wall area. Thus we get the hourly heat loss through the net wall area:

$$H=0.255\times96\times70=1,710 \text{ Btu.}$$

For the window, if only the transmission is considered, we find, with a transmission coefficient for a single glass being $U=1.13$, that the hourly heat loss will be:

$$H=1.13\times12\times70=950 \text{ Btu.}$$

Therefore, the total loss of heat by transmission only through this composite wall will be 1,710+950=2,660 Btu. (It is important to remember that there will also be infiltration losses through the window cracks. See the following paragraphs.)

Note: Heat is lost from a building by transmission through all of those surfaces which separate heated spaces from the outside air or from unheated colder spaces within the building. In general, five kinds of surfaces are involved; 1. outside walls; 2. outside glass; 3. inside walls or partitions next to unheated spaces; 4. ceilings of upper floors, either below a cold attic or as the underside of a roof slab; 5. floors of heated rooms above unheated space.

Heat Losses through Infiltration. A building cannot be absolutely tight. There will always be leaks—for instance, around windows and doors. The air will also move through the building construction. Air-leakage losses are those resulting from the displacement of heated air by unheated outside air. This change of air is called infiltration and must be considered in heating and cooling calculations.

The air infiltration can either be determined according to the available window and door crack area or by estimating the total number of air changes per hour.

The first method of determining the heat loss through direct leakage is based on tests by Vorhees and Meyer (*Transactions,* American Society of Heating and Ventilating Engineers, Vol. XXII, p. 183) and others. By this method, compute the length of crack around the windows and assume an amount of air leakage per foot of crack depending upon the window construction. The amount of infiltration for various types of windows is given in the following table:

Infiltration through Cracks Around Windows and Doors

Type of Window	*Condition*	*Cubic feet per hour per foot of crack for various velocities in miles per hour*					
		5	10	15	20	25	30
Double-Hung Wood-Sash Windows (unlocked)	Average window, not weather-stripped	6.6	21.4	39.3	59.3	80.0	103.7
	Average window, weather-stripped	4.3	15.5	23.6	35.5	48.6	63.4
Double-Hung Metal Windows	not weather-stripped, unlocked	20	47	74	104	137	170
	Weather-stripped, unlocked	6	19	32	46	60	76
Steel-Sash Windows	Residential casement, average	14	32	52	76	100	128
	Heavy casement sections, average	8	24	38	54	72	92
Doors	Well fitted, not weather-stripped	27	69	111	154	200	249
	Well fitted, weather-stripped	14	35	55	77	100	125

Obviously it would not be correct to use the aggregate length of the cracks of the windows on all sides of a room, because air is usually flowing inward through some of them but outward through others.

Therefore, the following rulings have been set forth:

Room with one wall exposed—Take the total feet of cracks.

Room with two walls exposed—Take the wall with the greater number of feet of cracks.

Room with 3 or 4 walls exposed—Take the wall with the greatest number of feet of cracks, but in no case less than half the total number of feet of cracks.

The amount of air leakage through the wall which is plastered or contains building paper, properly applied, is usually so small that it may be neglected. As this is the case with all modern buildings today, this case can be neglected.

The second method is to assume that the volume of air in a room or building is renewed a certain number of times per hour. This method is simple and sufficiently accurate in some cases. The number of air changes usually assumed are given in the table below for various types of rooms. (From p. 126, A.S.H.V.E. Guide.)

Air Changes Taking Place under Average Conditions Exclusive of Air Provided for Ventilation

Kind of Room or Building	*Number of Air Changes Taking Place Per Hour*
Rooms, 1 side exposed	1
" 2 sides exposed	1½
" 3 sides exposed	2
" 4 sides exposed	2
Rooms with no windows or outside doors	½–¾
Entrance Halls	2–3
Reception Halls	2
Living Rooms	1–2
Dining Rooms	1–2
Bathrooms	2

Heat Loss Due to Infiltration. The heat required to supply infiltration losses must be sufficient to warm the air which enters a room by infiltration from the temperature of the outside air to that of the room, as given by the following formula. The specific heat of air is assumed to be 0.24 (to be more correct, this is the specific heat of air at constant pressure; the correct value as found by Regnault is 0.2375 Btu, but this includes the work of expansion).

$$H=0.24\ Q\ d\ T$$

H=Btu per hour required for heating air leaking into the building.

Q=cubic feet of air entering per hour at inside temperature.

d=weight per cubic foot of air of inside temperature.

T=temperature difference between outside and inside air.

By using a room temperature of 70 degrees, the value of d becomes 0.075 pounds per cubic foot, so the above equation is reduced to:

$$H=0.018\ Q\ T$$

Example: A room $12' \times 8'$, with a 9-foot ceiling, has two walls exposed. Find the heat loss through infiltration for an outside temperature of zero degrees. The room temperature is assumed to be 70 degrees.

The volume of the room is $12 \times 8 \times 9 = 864$ cubic feet. There are 1½ air changes per hour. Hence:

$$Q=864 \times 1\tfrac{1}{2}=1{,}296 \text{ cubic feet}$$

The following table gives the weight of air at 70 degrees to be 0.075 pounds per cubic foot, so we get the hourly heat loss to be:

$$H=0.24 \times 1{,}296 \times 0.075 \times 70=1{,}634 \text{ Btu.}$$

By using the second formula, where already the weight of air at the temperature of 70 degrees has been considered, we get the hourly heat loss to be:

$$H=0.018 \times 1{,}296 \times 70=1{,}634 \text{ Btu.}$$

We can also use the table, where the value of $0.24 \times d \times T$ is given as 1.260 Btu per 1 cubic foot of air of 70-degrees temperature. As the total air volume has been found to be 1,296 cubic feet, we get the total heat loss per 1 hour again to be:

$$H=1{,}296 \times 1.26=1{,}634 \text{ Btu.}$$

Heat Value of One Cubic Foot of Room Air in Btu.
Value of $0.24 \times d \times T$, where T is the difference between inside and outside air temperature.

Outside Temperature	*Inside Temperature*				
	60	65	70	75	80
−10	1.283	1.361	1.440	1.513	1.588
0	1.110	1.179	1.260	1.335	1.411
+10	0.917	0.998	1.080	1.158	1.235
+20	0.733	0.816	0.900	0.980	1.058
+30	0.550	0.635	0.720	0.802	0.882
Weight of 1 cubic foot of air at this temperature	0.764	0.756	0.0750	0.0742	0.0735

ADDITIONAL FACTORS ON HEAT LOSS

Intermittent Heating. When the heating of a building is discontinued, it will be necessary to reheat the building, since both walls and contents have cooled off. Thus, for rooms heated in the day time only, 10% should be added to the minimum heat requirement, and, in case they are to remain unheated for longer intervals than overnight, it is suggested to make the increase 25%. The expression for this addition to the required heat amount is "pickup load."

Exposure. Coefficients given and used are based upon the assumption of an average wind velocity of 15 mph. Exposure corrections, therefore, are necessary for ordinary calculations.

For a very unobstructed northern exposure it is advisable to multiply heat losses by 1.15–1.30; and for similar east and west exposures, by 1.05–1.15.

Temperature of Unheated Rooms. Sometimes it is sufficient to assume the temperature of unheated rooms to be at a temperature about halfway between the outside and inside design temperature. This applies to unheated closed attics.

The A.S.H.V.E. Guide recommends: That heat loss through floors into basements and into unheated rooms kept closed may be computed by assuming a temperature for these rooms of 32 degrees.

Temperatures of Rooms with High Ceilings. Where the ceilings are higher than 12 feet, the temperature at the breathing line will be lower than the temperature designed. About 10% additional heating surface will take care of these rooms up to 20-foot ceiling height.

WATER FOR THE "HOUSE OF HEALTH"

In a properly designed house nothing is left to chance, and all contingencies are provided for. The frequent complaints that the water pressure is not great enough, or that the water is not hot enough, will not be heard from those living in a "House of Health." Do you know how much water your family needs, or how much it will cost you to heat a tub of bath water? Data given here will answer all of your questions of this nature.

Water Consumption is calculated in two ways. First, the total amount required over a certain period; and second, the volume that might be required at one time. It is considered that one person requires 100 gallons of cold water per day. The hot-water requirements per person per day are usually from ¼ to ⅓ of the cold-water requirements, and the most water that is needed at one time is considered to be about 10% more than the average daily hot-water consumption. From this data the hourly demand, the additional boiler capacity for heating water, and, also, the approximate size of the hot-water storage tank can be calculated. Since all heating costs are based on square feet of radiation, the table below gives, along with the hot-water and cold-water requirements, the corresponding increases in radiation for various size houses. This means that the greater the hot-water requirement, the greater the boiler capacity must be.

Water Consumptions for Residences

Type of House	*Cold Water per day*	*Hot Water per day*	*Peak Hour*	*Increase in Radiation*	
				Steam Heat	*Hot Water*
Kitchen, Laundry, Bathroom	500	167	17	59	94
Kitchen, Laundry, Bathroom, and Lavatory	540	180	18	63	100
Kitchen, Laundry, 2 Bathrooms, and Lavatory	640	213	22	75	119
Kitchen, Laundry, 3 Bathrooms, and Lavatory	740	246	25	86	138

The Cost of Heating Water. It is usually considered that hot tap water is 100 degrees hotter than the cold water. Since it requires 833 Btu of heat to raise one gallon of water 100 degrees, and since one million Btu cost approximately 60¢ through the heating system, the cost of heating one gallon of water to 100 degrees will be 0.05¢ per gallon.

The Cost of a Bath. Since the average bathtub is 5 feet long and 2 feet wide, and assuming the water to be 1 foot deep, the amount of water required is 10 cubic feet. There are 7.5 gallons to the cubic foot, and, therefore, 75 gallons of hot water are required. Therefore, the cost of the average bath will be 75×0.05, or 3.8¢. For larger tubs the cost will be greater.

Additional Cost of Hot Water. Obviously a larger boiler is required if, in addition to heating the house, it is expected to heat water. Since boiler capacities are calculated in square feet of steam radiation, and since 1 square foot of steam radiation is equivalent to 240 Btu of heat, and since it requires 833 Btu to raise one gallon of water 100 degrees, it will take $\frac{833}{240}=3.47$ square feet of equivalent steam radiation to raise one gallon of water 100 degrees. Since 1 square foot of hot-water radiation is equal to 150 Btu, it will require $\frac{833}{150}=5.55$ square feet of hot-water radiation to accomplish the same result.

With this information and the water requirements as determined from the previous table, the increases in boiler capacity may be calculated, and the cost of this increased boiler capacity must be charged against the cost of supplying your house with hot water. The actual size of the boiler will be determined after the other factors influencing its design are considered, such as heat losses.

THE COMPUTATION OF HEAT LOSSES

Assume a room 20′×15′×10′ with two exposed walls made of 4 inches of common brick and 8 inches of hollow tile—furred, lathed and plastered—with 4 windows—2 in each wall—of single-thickness glass 4′×6′, and a double floor with lath and plaster below the floor beams—over an unheated basement. What are the heat losses if the room temperature is to be kept at 70 degrees against an outside temperature of zero degrees? As there is a heated room above, there will be no heat losses through the roof.

General Data. The coefficient of heat transmission for the wall is U=0.255; and for the windows, U=1.13; and for the double floor, U=0.25. Glass area is equal to 48 square feet, and net wall area is equal to 312 square feet. Floor area is equal to 300 square feet, and the volume of the room is equal to 3,000 cubic feet. Heat is lost from the room by transmission through the windows, walls and floors, as well as by infiltration.

The Losses by Transmission, using the above coefficients, are as follows:

Through	walls	0.255×312×70=5,560 Btu
"	windows	1.13 × 48×70=3,800 Btu
"	floor	0.25 ×300×38=2,850 Btu
	Total Heat Losses	12,210 Btu

The Loss by Infiltration. In calculating infiltration losses, the total length of the cracks around windows and doors must be measured. In this case the horizontal and vertical cracks around windows equal 48 lineal feet, and, since for this type of double-hung window the infiltration is assumed to be 39.3 cubic feet per lineal foot of crack per hour, the amount of air coming into the room to be heated will be 48×39.3=1,890 cubic feet per hour. Thus, the heat loss will be 0.018×1,890×70=2,380 Btu.

Another method of calculating heat losses through infiltration is as follows. Assume that the air in the room is completely changed 1½ times per hour. The number of cubic feet of air to be heated every hour will be 1½×3,000, or 4,500 cubic feet, and the heat loss will be 0.018×4,500×70=5,660 Btu.

Total Heat Losses. Using this value, plus the heat losses by transmission, we get the total heat loss in the room to be 12,210+5,660 =17,870 Btu per hour. This must be taken into consideration in calculating the radiation to be supplied in the room.

Computation of Radiation. The heat losses obtained for each room in the manner outlined above are divided by 240 Btu if a steam-heating system is used, and by 150 Btu if a hot-water system is used. The result will be the equivalent square feet of radiation. Thus, for a steam-heating system the square foot of radiation required for the room described above will be 17,870÷240=72 square feet.

THE SIZE OF THE BOILER

When calculations for the whole house have been completed in the manner shown above, we are ready to calculate the size of the boiler. The total room radiations have been found to be 440.* All the manufacturers of boilers will tell you their rated capacities. To arrive at the proper size for your house, we add up the following items that have been previously determined:

1. Total Room Load: 440
   That is, the total number of square feet of radiation required for all rooms.
2. Pipe Losses: 15% of 440 66
   Which are determined by adding 15% to the above requirements if the pipes are insulated and 60% if they are not insulated.
3. Pickup Load: 50% of 506 253
   Obtained by adding the first two items and increasing the sum by 25%–50%.
4. Hot Water: 63
   Use the value given in the table.

Total 822

The sum will be the total boiler capacity in square feet of radiation.

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*The pipes are insulated, and the house has one bathroom and one lavatory.

CONDUCTIVITIES AND RESISTIVITIES OF BUILDING MATERIALS AND INSULATORS

MATERIAL	Conductivity or Conductance*	Resistivity or Resistance*
MASONRY MATERIALS		
Brick, Common	5.00	.20
Face	9.20	11
Brickwork, damp or wet	5.00	.20
Cement Mortar	12.00	.08
Cinder Concrete	5.20	.19
Cinder Blocks— 8 inch } note (a)	.62*	1.61*
12 inch } note (a)	.51*	1.96*
Concrete	12.00	.08
Gypsum Fibre Concrete	1.66	.60
Concrete Blocks— 8 inch	1.00*	1.00*
12 inch	.80*	1.25*
Stone	12.50	.08
Stucco	12.00	.08
Hollow Clay Tile— 4 inch	1.00*	1.00*
6 inch } note (b)	.64*	1.57*
8 inch } note (b)	.60*	1.67*
10 inch } note (b)	.58*	1.72*
12 inch } note (b)	.40*	2.50*
16 inch } note (b)	.31*	3.23*
Hollow Gypsum Tile— 4 inch	.46*	2.18*
Tile or Terrazzo	12.00	.08
BUILDING CONSTRUCTIONS		
Frame		
Fir Sheathing (1") Building Paper	.71*	1.41*
Fir Sheathing (1") Building Paper and Yellow Pine Lap Siding	.50*	2.00*
Fir Sheathing (1") Building Paper and Stucco	.82*	1.22*
Pine Lap Siding and Building Paper Siding 4" wide	85*	1 18*
Yellow Pine Lap Siding	1.28*	78*
Flooring		
Battleship linoleum (¼")	1.36*	74*
Woods (Across Grain)		
Maple or Oak (typical hardwoods)	1.15	87
Yellow Pine or Fir (typical softwoods)	.80	1 25
ROOFING CONSTRUCTIONS		
Roofing		
Asphalt, composition or prepared	6.50*	15*
Built-up—⅜ inch thick	3.53*	.28*
Shingles		
Asbestos	6.00*	.17*
Asphalt	6.50*	.15*
Slate	10.37	.10
Wood	1.28*	.78*
PLASTERING MATERIALS		
Plaster (Gypsum)	3.30	.30
Metal Lath and Plaster (¾")	4.40*	.23*
Wood Lath and Plaster	2.50*	.40*
Plaster Board—⅜ inch	3.73*	.27*
½ inch	2.82*	.35*
INSULATING MATERIALS		
Blanket or Flexible Fiber	.27	3.70
Loose fill or bat type		
Gypsum (flaked, dry and fluffy)	.48	2.08
Mineral Wool, all forms	.27	3.70
Rock Wool, Glass Wool	.27	3.70
Rigid,		
Corkboard	.30	3.33
Fiber, typical wood, cane, etc	.33	3.03
Reflective Type (see below, Air Spaces faced with reflective metals aluminum foil)		
AIR SPACE AND SURFACE COEFFICIENTS		
Air Spaces, over ¾" faced with ordinary building materials	1 10*	91*
Surfaces, Ordinary, Still air	1.65*	.61*
Air in motion, 15 mph	6.00*	17*
AIR SPACES FACED WITH REFLECTIVE METALS (ALUMINUM FOIL)		
Air space, faced one side with foil: over ¾" wide	.46*	2.17*
Air space, faced one side with foil: ⅜" wide	.62*	1.61*
Air space, faced both sides with foil, over ¾" wide	41*	2.44*
Air space, faced both sides with foil: ⅜" wide	.57*	1.75*
Air space divided in two with single curtain of foil (both sides bright) Each space over ¾" wide	23*	4.35*
Each space ⅜" wide	31*	3.23*
Air space with multiple curtains of foil, bright both sides, curtains more than ¾" apart, in standard construction:		
2 curtains forming 3 spaces	15*	6.78*
3 curtains forming 4 spaces	.11*	9.22*
4 curtains forming, 5 spaces	.09*	11.66*

NOTES

indicates conductances and resistances for the thickness stated or used in construction, not per 1 inch thickness. All values not so marked are conductivities or resistivities and must be proportionately modified if the material is used in any other net thickness than 1 inch

(a) One air cell in direction of heat flow

(b) Hollow tile values for 6" 8" and 10" units are based on two air cells in the direction of heat flow. The 12" tile is based on three cells in the direction of heat flow The 16" hollow tile consists of one 10" and one 16" tile, each having two cells in direction of heat flow.

All values are taken from A.S.H.V.E. Guide 1936, Chapter 5, Table 2, "Conductivities and Conductances of Building Materials and Insulators" and are those recommended for computing heat transmission coefficients

COEFFICIENTS OF TRANSMISSION (U) FOR DOORS, WINDOWS, SKYLIGHTS, GLASS MASONRY*

Windows and Skylights	U
Single sheet of glass (window or plate)	1.13
Double sheets of glass (compound lights, storm sash, etc.)	.45
Triple sheets of glass	.28
Glass Masonry	
Hollow glass blocks**	.50*
Panel Wood Doors (assumed same as glass)	1.13
Solid Wood Doors (calculated values)	

Nominal thickness	*Actual thickness*	
1	25/32	.69
1¼	1 1/16	.59
1½	1 5/16	.52
1¾	1⅜	.51
2	1⅝	.46
2½	2⅛	.38
3	2⅝	.33

*All other data, except as above, from A.S.H.V.E. Guide, 1936, Ch. 5, Table 13.

**Tentative value, based on average of tests on three types of units, pending greater accumulation of data. All values assume 15 mph wind velocity.

COEFFICIENTS OF HEAT RESISTANCE (R) AND HEAT TRANSMISSION (U) FOR FLOORS AND CEILINGS

BASIC CASE. Maple or Oak Flooring on Yellow Pine Sub-Flooring nailed to floor joists. Ceiling consists of ¾ inch Plaster on Metal Lath

Top air film	0.61
Maple or Oak Flooring (13/16)	0.71
Yellow Pine Sub-Flooring (25/32)	0.97
Air space between joists	0.91
¾ inch Plaster on Metal Lath	0.23
Bottom air space	0.61

Overall Resistance R=4.04

Overall Transmission U=1/R=0.247

Variations. (Unless otherwise noted, the same as basic case)	*Coefficients* R	U	*The figuring of the value of R*
Basic Case without flooring (for instance ceiling below attic)	1.45	0.690	*R—1.68—0.91*
Basic Case without ceiling (for instance floor over basement)	2.90	0.344	*R—0.23—0.91*
Basic Case with ceiling of ½ in. Plaster (0.15) on ½ in. Rigid Insulation (1.51)	5.47	0.183	*R—0.23+1.66*
Basic Case with ½ in. Blanket Insulation (1.85) between joists—two airspaces	6.80	0.147	*R+1.85+0.91*
Basic Case with 3⅝ in. Rock Wool Insulation (13.40) between joists—one airspace	17.44	0.057*	*R+13.40*

COEFFICIENTS OF HEAT RESISTANCE (R) AND HEAT TRANSMISSION (U) FOR PITCHED ROOFS

BASIC CASE. Asphalt Shingles, Rigid Asbestos Shingles, Composition Roofing, or Slate or Tile Roofing on Wood Sheathing, nailed to Rafters. No Ceiling (Rafters exposed).

Outside air film	0.17
Roofing (average)	0.15
Sheathing (25/32)	0.97
Inside air film	0.61

Overall Resistance R=1.90

Overall Transmission U=1/R=0.526**

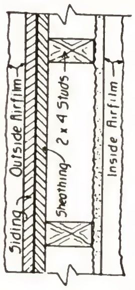
Variations. (Unless otherwise noted, the same as basic case)	*Coefficients* R	U	*The figuring of the value of R*
Basic Case with ¾ in. Plaster on Metal Lath, applied directly to Roof Rafters	3.04	0.329	*R+0.23+0.91*
Basic Case with ¾ in. Plaster on Metallated Lath applied directly to the Rafters	4.30	0.232	*R+2.17+0.23*
Basic Case with ½ in. Plaster (0.15) on ½ in. Rigid Insulation (1.51) applied directly to Roof Rafters	4.47	0.223	*R+1.66+0.91*
Basic Case with 1 in. Blanket Insulation (3.70) between joists —one airspace	6.51	0.153	*R+3.70+0.91*
Basic Case with 1 in. Blanket Insulation (3.70) between joists, with ¾ in. Plaster on Metal Lath—Two airspaces	7.65	0.131	*R+0.91+3.70* *+0.91+0.23*

*This value does not agree with the corresponding value in the A. S. H. V. E. Guide. Apparently the airspace is neglected.

**This value does not agree with the corresponding value in A. S. H. V. E. Guide.

COEFFICIENTS of Heat Resistance (R) and Heat Transmission (U) for Frame Walls (U=1/R)

● *BASIC CASE I.* Siding or Clapboards, Building Paper and Wood Sheathing, 4 in. Studs, and ¾ in. Plaster on Metal Lath.



Outside air film	0.17
Siding	0.78
Building Paper and Sheathing	1.22
Airspace between Studs	0.91
¾ in. Plaster on Metal Lath	0.23
Inside air film	0.61
Overall Resistance	R=3.92
Overall Transmission	U=1/R=0.255

Variations. (Unless otherwise noted, the same as basic case)

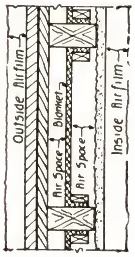
Exterior Finish: Wood Siding, Clapboards, Wood Shingles, Asbestos Shingles,[1] Stucco,[2] Face Brick,[3] Common Brick.[6]

Sheathing: Wood Sheathing, ½ in. Rigid Insulation,[7] 1 in. Rigid Insulation,[8] ½ in. Plasterboard.[4]

Insulation: None between Studs.

Inside Finish: (*Values inside parentheses give total resistance for material mentioned only*)	Coefficients R	U	*The figuring of the values of R*
¾ in. Plaster on Metal Lath[9] attached to Studding	**3.92**	**0.255**	*Basic value R*
½ in. Plaster (0.15) on			
⅜ in. Plasterboard (0.27)	**4.11**	**0.243**	*R–0.23+0.42*
½ in. Rigid Insulation (1.51)	**5.35**	**0.187**	*R–0.23+1.66*
1 in. Rigid Insulation (3.03)	**6.87**	**0.147**	*R–0.23+3.18*
No Plaster. Decorated Building Board attached direct to Studding			
⅜ in. Plasterboard (0.27)	**3.96**	**0.252**	*R–0.23+0.27*
½ in. Rigid Insulation (1.51)	**5.20**	**0.192**	*R–0.23+1.51*
1 in. Rigid Insulation (3.03)	**6.72**	**0.151**	*R–0.23+3.03*

BASIC CASE II. Siding or Clapboards, Building Paper and Wood Sheathing, 4 in. Studs, and ¾ in. Plaster on Metal Lath. Blanket Insulation between Studs with two airspaces.



Outside air film	0.17
Siding	0.78
Building Paper and Sheathing	1.22
Two airspaces	1.82
½ in. Blanket Insulation	1.85
¾ in. Plaster on Metal Lath	0.23
Inside air film	0.61
Overall Resistance	R=6.68
Overall Transmission	U=1/R=0.150

Variations. (Unless otherwise noted, the same as basic case)

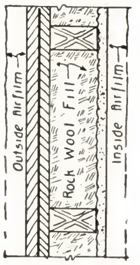
Exterior Finish: Wood Siding, Clapboards, Wood Shingles, Asbestos Shingles,[1] Stucco,[2] Face Brick,[3] Common Brick.[6]

Sheathing: Wood Sheathing, ½ in. Rigid Insulation,[7] 1 in. Rigid Insulation,[8] ½ in. Plasterboard.[4]

Insulation: ½ in. or 1 in. Blanket Insulation between Studs. (One airspace only, deduct 0.91).

Inside Finish: (*Values inside parentheses give total resistance for material mentioned only*)	Coefficients R	U	*The figuring of the values of R*
¾ in. Plaster on Metal Lath[9] attached to the Studding with			
½ in. Blanket Insulation	**6.68**	**0.150**	*Basic value R*
1 in. Blanket Insulation (3.70)	**8.53**	**0.117**	*R+1.85*
½ in. Plaster (0.15) on			
⅜ in. Plasterboard (0.27)	**6.87**	**0.146**	*R–0.23+0.42*
½ in. Rigid Insulation (1.51)	**8.11**	**0.123**	*R–0.23+1.66*
1 in. Rigid Insulation (3.03)	**9.63**	**0.104**	*R–0.23+3.18*
No Plaster. Decorated Building Board attached direct to Studding			
⅜ in. Plasterboard (0.27)	**6.72**	**0.149**	*R–0.23+0.27*
½ in. Rigid Insulation (1.51)	**7.96**	**0.126**	*R–0.23+1.51*
1 in. Rigid Insulation (3.03)	**9.48**	**0.105**	*R–0.23+3.03*

BASIC CASE III. Siding or Clapboard, Building Paper and Wood Sheathing, and ¾ in. Plaster on Metal Lath attached to Studding. Airspace between Studding filled with Rock Wool Insulation.



Outside air film	0.17
Siding	0.78
Building Paper and Sheathing	1.22
3¾ in. Rock Wool	13.40
¾ in. Plaster on Metal Lath	0.23
Inside air film	0.61
Overall Resistance	R=16.41
Overall Transmission	U=1/R=0.061

Variations. (Unless otherwise noted, the same as basic case)

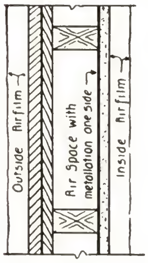
Exterior Finish: Wood Siding, Clapboards, Wood Shingles, Asbestos Shingles,[1] Stucco,[2] Face Brick,[3] Common Brick.[6]

Sheathing: Wood Sheathing, ½ in. Rigid Insulation,[7] 1 in. Rigid Insulation,[8] ½ in. Plasterboard.[4]

Insulation: 3¾ in. Rock Wool, 1⅝ in. Rock Wool with one airspace.[5]

Inside Finish: (*Values inside parentheses give total resistance for material mentioned only*)	Coefficients R	U	*The figuring of the values of R*
¾ in. Plaster on Metal Lath[9] attached to the Studding with			
3¾ in. Rock Wool, no airspace	16.41	**0.061**	*Basic value R*
1⅝ in. Rock Wool (6.01) with one airspace (0.91)	9.93	**0.101**	*R–13.40+6.92*
½ in. Plaster (0.15) on			
⅜ in. Plasterboard (0.27)	**16.60**	**0.060**	*R–0.23+0.42*
½ in. Rigid Insulation (1.51)	**17.84**	**0.056**	*R–0.23+1.66*
1 in. Rigid Insulation (3.03)	**19.36**	**0.052**	*R–0.23+3.18*
No Plaster. Decorated Building Board attached direct to Studding.			
⅜ in. Plasterboard (0.27)	16.45	**0.061**	*R–0.23+0.27*
½ in. Rigid Insulation (1.51)	17.69	**0.057**	*R–0.23+1.51*
1 in. Rigid Insulation (3.03)	19.21	**0.052**	*R–0.23+3.03*

BASIC CASE IV. Siding or Clapboards, Building Paper and Wood Sheathing, and ¾ in. Plaster on Metallated Lath—airspace thus faced one side with metallation.



Outside air film	0.17
Siding	0.78
Building Paper and Sheathing	1.22
Airspace faced one side with metallation	2.17
¾ in. Plaster on Metal Lath	0.23
Inside air film	0.61
Overall Resistance	R=5.18
Overall Transmission	U=1/R=0.193

Variations. (Unless otherwise noted, the same as basic case)

Exterior Finish: Wood Siding, Clapboards, Wood Shingles, Asbestos Shingles,[1] Stucco,[2] Face Brick,[3] Common Brick.[6]

Sheathing: Wood Sheathing, ½ in. Rigid Insulation,[7] 1 in. Rigid Insulation,[8] ½ in. Plasterboard.[4]

Insulation: Metallation on side, with one curtain, two curtains, etc.

Inside Finish: ¾ in. Plaster on Metallated Lath, attached to the Studding. (For ordinary Metal Lath and Plaster, deduct 1.26.)

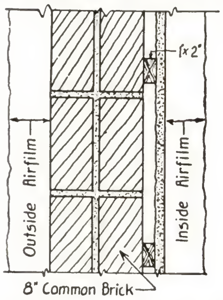
	Coefficients R	U	*The figuring of the values of R*
Furring Space metallated one face only (2.17)			
No curtain	**5.18**	**0.193**	*Basic value R*
One curtain (2.44)	**7.62**	**0.131**	*R+2.44*
Two curtains (4.88)	**10.06**	**0.094**	*R+4.88*
Furring Space metallated two faces (2.44)			
No curtain	**5.45**	0.183	*R–2.17+2.44*
One curtain (2.44)	**7.89**	0.127	*R–2.17+4.88*
Two curtains (4.88)	**10.33**	0.097	*R–2.17+7.32*
Furring Space not metallated			
One curtain (4.34)	**7.35**	0.136	*R–2.17+4.34*
Two curtains (6.78)	**9.79**	0.102	*R–2.17+6.78*

Notations: The value of R is always figured first. Then the value of U is the reciprocal value of R. Thus U=1/R.

[1] Asbestos Shingles	deduct	0.61	from	value of R
[2] 1 in. Stucco	deduct	0.70	from	value of R
[3] 4 in. Veneer of Face Brick	deduct	0.34	from	value of R
[4] ½ in. Plasterboard	deduct	0.87	from	value of R
[5] 1⅝ in. Rock Wool with one airspace	deduct	6.48	from	value of R
[6] 4 in. Veneer of Common Brick	add	0.02	to	value of R
[7] ½ in. Rigid Insulation	add	0.29	to	value of R
[8] 1 in. Rigid Insulation	add	1.81	to	value of R
[9] Wood Lath and Plaster	add	0.17	to	value of R

COEFFICIENTS of Heat Resistance (R) and Heat Transmission (U) for Common Brick Walls (U=1/R)

● *BASIC CASE V.* 8 in. Common Brick, ¾ in. Plaster on Metal Lath, attached to 1″×2″ Furring Strips.



Outside air film	0.17
8 in. Common Brick	1.60
Airspace (Furring Space)	0.91
¾ in. Plaster on Metal Lath	0.23
Inside air film	0.61

Overall Resistance R=3.52
Overall Transmission
U=1/R=0.284

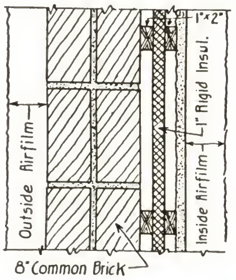
Variations. (Unless otherwise noted, the same as basic case)

Wall: 8 in. Common Brick, 4 in. Common with 4 in. Face Brick[1]
12 in. Common Brick,[2] 8 in. Common with 4 in. Face Brick[3]

Insulation: None in Furring Space.

Inside Finish: (*Values inside parentheses give total resistance for material mentioned only*)	*Coefficients*		*The figuring of the value of R*
	R	U	
¾ in. Plaster on Metal Lath[4]	3.52	0.284	*Basic value of R*
¾ in. Plaster on Metallated Lath (2.17)	4.78	0.209	*R−0.91+2.17*
½ in Plaster (0.15) on			
⅜ in. Plasterboard (0.27)	3.71	0.270	*R−0.23+0.42*
½ in. Rigid Insulation (1.51)	4.95	0.202	*R−0.73+1.66*
1 in. Rigid Insulation (3.03)	6.47	0.154	*R−0.23+3.18*
No Plaster. Decorated Building Board attached directly to Furring Strips			
⅜ in. Plasterboard (0.27)	3.56	0.280	*R−0.23+0.27*
½ in. Rigid Insulation (1.51)	4.80	0.208	*R−0.23+1.51*
1 in. Rigid Insulation (3.03)	6.32	0.158	*R−0.23+3.03*

BASIC CASE VI. 8 in. Common Brick, 1 in. Rigid Insulation between double Furring Strips 1″×2″ with two airspaces, ¾ in. Plaster and Metal Lath attached to Furring Strips.



Outside air film	0.17
8 in. Common Brick	1.60
Two airspaces	1.82
1 in. Rigid Insulation	3.03
¾ in. Plaster on Metal Lath	0.23
Inside air film	0.61

Overall Resistance R=7.46
Overall Transmission
U=1/R=0.134

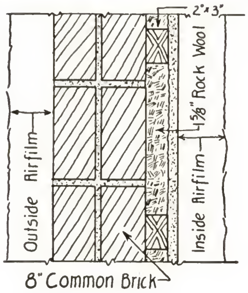
Variations. (Unless otherwise noted, the same as the basic case)

Wall: 8 in. Common Brick, 4 in. Common with 4 in. Face Brick[1]
12 in. Common Brick,[2] 8 in. Common with 4 in. Face Brick[3]

Insulation: 1 in. Rigid Insulation, ½ in. Blanket Insulation[5] in Furring Space

Inside Finish: (*Values inside parentheses give total resistance for material mentioned only*)	*Coefficients*		*The figuring of the value of R*
	R	U	
¾ in. Plaster on Metal Lath[4]	7.46	0.134	*Basic value of R*
¾ in. Plaster on Metallated Lath (2.17)	8.72	0.115	*R−0.91+2.17*
½ in. Plaster (0.15) on			
⅜ in. Plasterboard (0.27)	7.65	0.131	*R−0.23+0.42*
½ in. Rigid Insulation (1.51)	8.89	0.112	*R−0.23+1.66*
1 in. Rigid Insulation (3.03)	10.41	0.096	*R−0.23+3.18*
No Plaster. Decorated Building Board attached directly to Furring Strips			
⅜ in. Plasterboard (0.27)	7.50	0.133	*R−0.23+0.27*
½ in. Rigid Insulation (1.51)	8.74	0.114	*R−0.23+1.51*
1 in. Rigid Insulation (3.03)	10.26	0.097	*R−0.23+3.03*

BASIC CASE VII. 8 in. Common Brick, ¾ in. Plaster on Metal Lath attached to Studding 2″×3″. Airspace between Studding filled with Rock Wool Insulation.



Outside air film	0.17
8 in. Common Brick	1.60
1⅝ in. Rock Wool Insulation	6.01
¾ in. Plaster on Metal Lath	0.23
Inside air film	0.61

Overall Resistance R=8.62
Overall Transmission
U=1/R=0.116

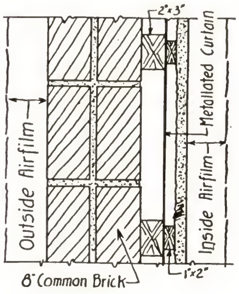
Variations. (Unless otherwise noted, the same as basic case)

Wall: 8 in. Common Brick, 4 in. Common with 4 in. Face Brick[1]
12 in. Common Brick,[2] 8 in. Common with 4 in. Face Brick[3]

Insulation: 1⅝ in. Rock Wool Insulation with no airspace

Inside Finish: (*Values inside parentheses give total resistance for material mentioned only*)	*Coefficients*		*The figuring of the value of R*
	R	U	
¾ in. Plaster on Metal Lath[4] attached to Furring Strips	8.62	0.116	*Basic value of R*
½ in. Plaster (0.15) on			
⅜ in. Plasterboard (0.27)	8.81	0.113	*R−0.23+0.42*
½ in. Rigid Insulation (1.51)	10.05	0.100	*R−0.23+1.66*
1 in. Rigid Insulation (3.03)	11.57	0.086	*R−0.23+3.18*
No Plaster. Decorated Building Board attached directly to Furring Strips			
⅜ in. Plasterboard (0.27)	8.66	0.115	*R−0.23+0.27*
½ in. Rigid Insulation (1.51)	9.90	0.101	*R−0.23+1.51*
1 in. Rigid Insulation (3.03)	11.42	0.087	*R−0.23+3.03*

BASIC CASE VIII. 8 in. Common Brick, Metallated Curtain between double Furring Strips, 2″×3″ and 1″×2″, with two airspaces, ¾ in. Plaster on Metal Lath attached to Furring Strips.



Outside air film	0.17
8 in. Common Brick	1.60
Two airspaces, metallated one face	4.34
¾ in. Plaster on Metal Lath	0.23
Inside air film	0.61

Overall Resistance R=6.95
Overall Transmission
U=1/R=0.144

Variations. (Unless otherwise noted, the same as basic case)

Wall: 8 in. Common Brick, 4 in. Common with 4 in. Face Brick[1]
12 in. Common Brick,[2] 8 in. Common with 4 in. Face Brick[3]

Insulation: Metallated Curtain between double Furring Strips

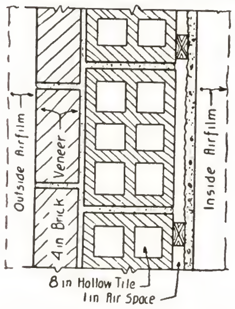
Inside Finish: (*Values inside parentheses give total resistance for material mentioned only*)	*Coefficients*		*The figuring of the value of R*
	R	U	
¾ in. Plaster on Metal Lath[4]	6.95	0.144	*Basic value of R*
¾ in. Plaster on Metallated Lath (2.44)	7.22	0.138	*R−2.17+2.44*
½ in. Plaster (0.15) on			
⅜ in. Plasterboard (0.27)	7.14	0.140	*R−0.23+0.42*
½ in. Rigid Insulation (1.51)	8.38	0.119	*R−0.23+1.66*
1 in. Rigid Insulation (3.03)	9.90	0.101	*R−0.23+3.18*
No Plaster. Decorated Building Board attached directly to Furring Strips			
⅜ in. Plasterboard (0.27)	6.99	0.143	*R−0.23+0.27*
½ in. Rigid Insulation (1.51)	8.23	0.121	*R−0.23+1.51*
1 in. Rigid Insulation (3.03)	9.75	0.103	*R−0.23+3.03*

Notations: The value of (R) is always figured first. Then the value of (U) is the reciprocal of the value of (R). Thus U=1/R.

[1] 4 in. Common and 4 in. Face Brick	deduct	0.36	from	value of R
[2] 12 in. Common Brick	add	0.80	to	value of R
[3] 8 in. Common and 4 in. Face Brick	add	0.44	to	value of R
[4] Wood Lath and Plaster	add	0.17	to	value of R
[5] ½ in. Blanket Insulation	deduct	1.18	from	value of R

COEFFICIENTS of Heat Resistance (R) and Heat Transmission (U) for Hollow Tile Walls (U=1/R)

● *BASIC CASE IX.* 4 in. Veneer of Common Brick, 8 in. Hollow Tile, ¾ in. Plaster on Metal Lath, attached to 1″×2″ Furring Strips.



Outside air film	0.17
Common Brick plus ½ in. Mortar	0.84
8 in. Hollow Tile	1.67
Airspace (Furring Space)	0.91
¾ in. Plaster on Metal Lath	0.23
Inside air film	0.61

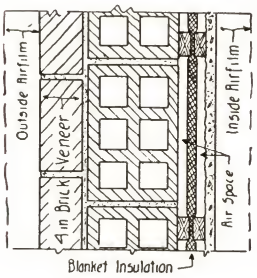
Overall Resistance R=4.43
Overall Transmission
U=1/R=0.226

Variations. (Unless otherwise noted, the same as basic case)

Facing: 4 in. Veneer of Common Brick, Face Brick,[1] Cut Stone[2]
1 in. Stucco[3] applied directly on backing
Backing: 8 in. Hollow Tile, Cinder Block,[4] Concrete Block,[5] Common Brick[6]
Insulation: None in Furring Space.

Inside Finish: (*Values inside parentheses give total resistance for material mentioned only*)	Coefficients R	U	*The figuring of the value of R*
¾ in. Plaster on Metal Lath[7]	4.43	0.226	*Basic value of R*
¾ in. Plaster on Metallated Lath (2.17)	5.69	0.176	*R−0.91+2.17*
½ in. Plaster (0.15) on			
⅜ in. Plasterboard (0.27)	4.62	0.216	*R−0.23+0.42*
½ in. Rigid Insulation (1.51)	5:86	0.170	*R−0.23+1.66*
1 in. Rigid Insulation (3.03)	7.38	0.135	*R−0.23+3.18*
No Plaster. Decorated Building Board attached directly to Furring Strips			
⅜ in. Plasterboard (0.27)	4.47	0.224	*R−0.23+0.27*
½ in. Rigid Insulation (1.51)	5.71	0.175	*R−0.23+1.51*
1 in. Rigid Insulation (3.03)	7.23	0.138	*R−0.23+3.03*

BASIC CASE X. 4 in. Veneer of Common Brick, 8 in. Hollow Tile, ½ in. Blanket Insulation between double Furring Strips 1″×2″ with two airspaces, ¾ in. Plaster on Metal Lath, attached to Furring Strips.



Outside air film	0.17
4 in. Common Brick plus ½ in. Mortar	0.84
8 in. Hollow Tile	1.67
Two airspaces	1.82
½ in. Blanket Insulation	1.85
¾ in. Plaster on Metal Lath	0.23
Inside air film	0.61

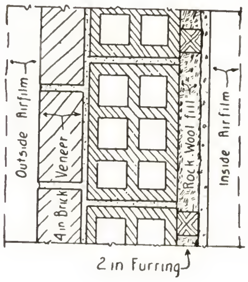
Overall Resistance R=7.19
Overall Transmission
U=1/R=0.139

Variations. (Unless otherwise noted, the same as basic case)

Facing: 4 in. Veneer of Common Brick, Face Brick,[1] Cut Stone[2]
1 in. Stucco[3] applied directly on backing
Backing: 8 in. Hollow Tile, Cinder Block,[4] Concrete Block,[5] Common Brick[6]
Insulation: ½ in. Blanket Insulation, 1 in. Rigid Insulation

Inside Finish: (*Values inside parentheses give total resistance for material mentioned only*)	Coefficients R	U	*The figuring of the value of R*
¾ in. Plaster on Metal Lath[7]	7.19	0.139	*Basic value of R*
¾ in. Plaster on Metallated Lath (2.17)	8.45	0.118	*R−0.91+2.17*
½ in. Plaster (0.15) on			
⅜ in. Plasterboard (0.27)	7.38	0.135	*R−0.23+0.42*
½ in. Rigid Insulation (1.51)	8.62	0.116	*R−0.23+1.66*
1 in. Rigid Insulation (3.03)	10.14	0.099	*R−0.23+3.18*
No Plaster. Decorated Building Board attached directly to Furring Strips			
⅜ in. Plasterboard (0.27)	7.23	0.138	*R−0.23+0.27*
½ in. Rigid Insulation (1.51)	8.47	0.118	*R−0.23+1.51*
1 in. Rigid Insulation (3.03)	9.99	0.100	*R−0.23+3.03*

BASIC CASE XI. 4 in. Veneer of Common Brick, 8 in. Hollow Tile, ¾ in. Plaster on Metal Lath attached to Furring Strips 2″×2″. Airspace between Furring Strips filled with Rock Wool Insulation



Outside air film	0.17
4 in. Common Brick plus ½ in. Mortar	0.84
8 in. Hollow Tile	1.67
1⅝ in. Rock Wool Insulation (1⅝×3.70)	6.01
¾ in. Plaster on Metal Lath	0.23
Inside air film	0.61

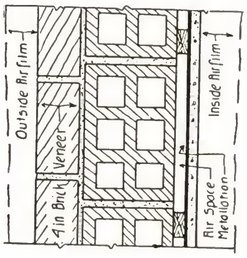
Overall Resistance R=9.53
Overall Transmission
U=1/R=0.105

Variations. (Unless otherwise noted, the same as basic case)

Facing: 4 in. Veneer of Common Brick, Face Brick,[1] Cut Stone[2]
1 in. Stucco[3] applied directly on backing
Backing: 8 in. Hollow Tile, Cinder Block,[4] Concrete Block,[5] Common Brick[6]
Insulation: 1⅝ in. Rock Wool with no airspace

Inside Finish: (*Values inside parentheses give total resistance for material mentioned only*)	Coefficients R	U	*The figuring of the value of R*
¾ in. Plaster on Metal Lath	9.53	0.105	*Basic value of R*
½ in. Plaster (0.15) on			
⅜ in. Plasterboard (0.27)	9.72	0.103	*R−0.23+0.42*
½ in. Rigid Insulation (1.51)	10.96	0.091	*R−0.23+1.66*
1 in. Rigid Insulation (3.03)	12.48	0.080	*R−0.23+3.18*
No Plaster. Decorated Building Board attached direct to Furring Strips			
⅜ in. Plasterboard (0.27)	9.57	0.104	*R−0.23+0.27*
½ in. Rigid Insulation (1.51)	10.81	0.092	*R−0.23+1.51*
1 in. Rigid Insulation (3.03)	12.33	0.081	*R−0.23+3.03*

BASIC CASE XII. 4 in. Veneer of Common Brick, 8 in. Hollow Tile, ¾ in. Plaster on Metallated Lath —airspace thus faced one side with metallation.



Outside air film	0.17
4 in. Common Brick plus ½ in. Mortar	0.84
8 in. Hollow Tile	1.67
Airspace faced one side with metallation (airspace over ¾ in.)	2.17
¾ in. Plaster on Metal Lath	0.23
Inside air film	0.61

Overall Resistance R=5.69
Overall Transmission
U=1/R=0.176

Variations. (Unless otherwise noted, the same as basic case)

Facing: 4 in. Veneer of Common Brick, Face Brick,[1] Cut Stone[3]
1 in. Stucco[3] applied directly on backing
Backing: 8 in. Hollow Tile, Cinder Block,[4] Concrete Block,[5] Common Brick[6]

Inside Finish: (*Values inside parentheses give total resistance for material mentioned only*)	Coefficients R	U	*The figuring of the value of R*
¾ in. Plaster on Metallated Lath			
No Curtain, airspace over ¾ in.	5.69	0.176	*Basic value of R*
One Curtain, airspaces ¾ in.	8.13	0.123	*R+2.44*
airspaces ⅜ in.	6.88	0.145	*R−2.17+3.36*
½ in. Plaster (0.15) on Metallated			
⅜ in. Plasterboard (0.27)			
No Curtain, airspace over ¾ in.	5.88	0.170	*R−0.23+0.42.*
One Curtain, airspaces ¾ in.	8.32	0.120	*R−0.23+2.86*
airspaces ⅜ in.	7.07	0.141	*R−2.40+3.78*
No Plaster. Decorated ⅜ in. Plasterboard, (0.27) metallated, attached directly to Furring Strips.			
No Curtain	5.73	0.175	*R−0.23+0.27*
One Curtain, airspaces ¾ in.	8.17	0.122	*R−0.23+2.71*
airspaces ⅜ in.	6.92	0.145	*R−2.40+3.63*

Notations: The value of (R) is always figured first. Then the value of (U) is the reciprocal of the value of (R). Thus U=1/R.

[1] 4 in. Veneer of Face Brick	deduct 0.36 from the value of R
[2] 4 in. Veneer of Cut Stone	deduct 0.48 from the value of R
[3] 1 in. Stucco	deduct 0.76 from the value of R
[4] 8 in. Cinder Block	deduct 0.06 from the value of R
[5] 8 in. Concrete Block	deduct 0.61 from the value of R
[6] 8 in. Common Brick	deduct 0.07 from the value of R
[7] Wood Lath and Plaster	add 0.17 to the value of R

The DEGREE-DAY

What every homeowner should know about it

THE DEGREE-DAY

● THE DEGREE-DAY is a unit, based upon temperature difference and time, used in specifying the normal heating load in winter. For any one day there exist as many degree-days as there are degrees Fahrenheit difference in temperature between the average outside air temperature, taken over a 24 hour period, and a temperature of 65 degrees Fahrenheit. This will be roughly a day temperature of 70 degrees.

Thus, if the mean temperature for the day is 60 degrees, 5 degree-days are counted, and if the mean temperature is 0 degrees Fahrenheit, 65 degree-days are counted.

By using this handy unit, the degree-day, the annual fuel requirements of your heating system can be established in advance. All that is necessary is to assume the expected temperatures and the number of sq. ft. of radiation in your house, and the other items as given below. A sq. ft. of radiation is discussed and defined in other chapters of this book. The term "sq. ft. of radiation" applies to either "net standing radiation" or "equivalent radiation"—which includes pipes, etc.—whichever is used in designing the system. Of course, in establishing fuel requirements in this manner it is assumed that the heating system as installed in your house is of the proper size and design. In other words, heating systems should be designed taking into consideration all features of the house which would increase or decrease the heating requirements and of such capacity as to maintain a temperature of, say, 70 degrees at the expected low temperatures of the year.

TECHNICAL DATA

The following factors and values can be assumed in calculating these heat requirements for a steam-heating system designed to maintain a temperature of 70 degrees with an outside temperature of 0 degrees and 100% efficiency of plant. The amount of fuel per sq. ft. of steam radiator per degree-day is 0.0006857 gals. of oil; 0.008 lb. of coal; 0.096 cu. ft. of gas, with the following heating values for the fuel: 140,000 Btu per gallon for the oil; 12,000 Btu per lb. for the coal; and 1,000 Btu per cu. ft. for the gas.

As explained in other articles in this book, there is a difference in the output of different types of heating systems. Therefore, the above values of fuel requirements, which apply to steam, must be multiplied by 5/8 if a hot-water system is used.

Of course, there are different types of oil, coal and gas, and if the rated heating value of these fuels is different from those given above, corrections should be made in these values.

HEAT VALUE OF FUEL ACTUALLY USED

The above figures are also based on a designed inside temperature of 70 degrees and outside temperature of 0 degrees. If the system is designed for other temperatures, multiply by the factor 70 degrees divided by 70 degrees minus the outside temperature designed for. For example, if your system is designed to maintain an inside temperature of 70 degrees Fahrenheit, with an outside temperature of 15 degrees, the correction factor applied to your fuel requirements as given above would be as follows: 70 divided by 70 minus 15.

The fuel requirements given above are based on 100% efficiency of the plant. This 100% efficiency is never obtained but is used merely to facilitate calculations, since corrections can more readily be made when 100% is used as a base than when such fractional figures as 68% are used. Thus, the correction necessary for the rated efficiency of your system is to divide the unit figure by the efficiency of your plant.

METHOD EXPLAINED BY EXAMPLES

Example A. What will be the oil consumption in the city of New York for an oil-burning heating plant, containing 400 sq. ft. of steam radiation, designed to maintain 70 degrees in zero weather; the oil having a heating value of 140,000 Btu per gallon and an efficiency of the system being assumed at 65%.

We have noted that 0.0006857 gallons of oil is required per square foot under certain conditions. With an efficiency of 65% we obtain 0.0006875/0.65 or 0.00105 gallons of oil required per degree-day per square foot of steam radiation.

Since our example gives 400 sq. ft. of radiators, we multiply 0.00105 by 400 and obtain 0.42 gallons of oil per degree-day. Since New York has 5,347 degree-days per normal season, the fuel consumption for a year will be 5,347 multiplied by 0.42, or 2,250 gallons of oil per season.

Example B. What will be the coal consumption in the city of Philadelphia for a stoker-operated heating plant, containing 400 sq. ft. of hot-water radiation, designed to maintain 70 degrees in weather 10 degrees above zero, the coal having a heating value of 10,000 Btu per lb. and an efficiency of the system being assumed at 55%?

We have noted that 0.008 of a lb. of coal is required under certain conditions. In our example a water system is installed instead of steam, so we multiply our 0.008 by ⅝ to obtain 0.005. Our system was designed for +10 degrees, so we multiply our 0.005 by 7/6 to obtain 0.00584. Assume a 55% operating efficiency, divide 0.00584 by 0.55, and we get 0.0106.

The heat value of the fuel in our example being 10,000 Btu per lb. instead of 12,000, we multiply the 0.0106 by $\frac{12,000}{10,000}$ to obtain 0.0127, which is pounds of coal required per degree-day per square foot of radiator. Since our example gives 400 sq. ft. of radiator, we multiply 0.0127 by 400 and obtain 5.08 lbs. of coal for this system per degree-day. Since Philadelphia has 4,855 degree-days per normal season, the fuel consumption for a year will be 4,855 multiplied by 5.08, or 24,663 lbs., or 12.3 tons.

CHECKING YOUR PRESENT HEATING SYSTEM

Suppose you know nothing about the number of square feet of radiation or the efficiency of the heating plant and all the other things mentioned above. You can still figure your fuel requirements for the coming year very simply. Suppose that last year you used 2,000 gals. of oil and that, according to the published tables, there were 6,000 degree-days in your town. By dividing the number of gallons of oil you used by the number of degree-days, which in this case would be 2,000 divided by 6,000, the answer is ⅓, which means that for every three degree-days last year you used one gallon of oil. This is the heating constant for your system, which is all that you need to know.

If you have a 550-gal. tank which you never want to let go lower than 75 gal., then whenever your calculations show that 475 gals. of oil have been consumed, you should order the tank to be filled. Four hundred seventy-five gallons will be consumed as soon as you have had three times as many degree-days, or 475×3=1,325 degree-days. You can check these degree-days in your local papers, which usually publish the mean temperature for the day before, and keep a record of them every day. This will take most of the guesswork out of your fuel supply and you need never be caught short.

NORMAL YEARLY DEGREE-DAYS FOR 94 CITIES

City	Normal Yearly Degree-Day
ALABAMA	
Birmingham	2352
Mobile	1471
Montgomery	1884
ARKANSAS	
Fort Smith	3213
Little Rock	2811
CALIFORNIA	
Los Angeles	1504
Sacramento	3127
San Francisco	3264
COLORADO	
Denver	5874
CONNECTICUT	
New Haven	5895
DISTRICT OF COLUMBIA	
Washington	4626
FLORIDA	
Jacksonville	890
Pensacola	1249
GEORGIA	
Atlanta	2890
Macon	2201
Savannah	1490
ILLINOIS	
Chicago	6290
Rockford	6847
Urbana	5805
INDIANA	
Ft. Wayne	5934
Indianapolis	5298
Terre Haute	4872
IOWA	
Davenport	6289
Des Moines	6384
Sioux City	6898
KANSAS	
Topeka	5307
Wichita	4673
KENTUCKY	
Louisville	4180
LOUISIANA	
Baton Rouge	1349
New Orleans	1024
MARYLAND	
Baltimore	4533
MASSACHUSETTS	
Amherst	6894
Boston	6045
Fitchburg	6632
Nantucket	5957
MICHIGAN	
Detroit	6490
Saginaw	7063
St. Joseph	6203
MINNESOTA	
Minneapolis	7850
Rochester	7986
MISSOURI	
Kansas City	4852
St. Louis	4585
NEBRASKA	
Omaha	6131
NEW HAMPSHIRE	
Concord	7353
NEW JERSEY	
Atlantic City	5176
Dover	6270
Jersey City	5193
Newark	5383
Paterson	5365
Trenton	4933
NEW MEXICO	
Albuquerque	4298
NEW YORK	
Albany	6580
Binghamton	6808
Buffalo	6822
Elmira	6412
New York	5347
Syracuse	6893
NORTH CAROLINA	
Greensboro	3527
NORTH DAKOTA	
Grafton	10278
OHIO	
Cincinnati	4703
Cleveland	6155
Dayton	5264
OKLAHOMA	
Oklahoma City	3613
OREGON	
Portland	4469
PENNSYLVANIA	
Erie	5866
Harrisburg	5375
Philadelphia	4855
Pittsburgh	5235
Reading	5389
Scranton	6129
Uniontown	5278
Williamsport	5450
RHODE ISLAND	
Providence	6014
SOUTH CAROLINA	
Charleston	1769
Columbia	2364
SOUTH DAKOTA	
Aberdeen	8279
TENNESSEE	
Chattanooga	3118
Nashville	3578
TEXAS	
Dallas	2287
Ft. Worth	2148
Houston	1157
San Antonio	1202
UTAH	
Salt Lake City	5555
VERMONT	
Burlington	7620
VIRGINIA	
Lynchburg	4019
Richmond	3725
WASHINGTON	
Seattle	4966
Spokane	6355
Tacoma	5181
Walla Walla	4809
WEST VIRGINIA	
Wheeling	5249
WISCONSIN	
Madison	7395
Milwaukee	7245
Sheboygan	7388

VARIOUS BUILDING COSTS

● ON THE FOLLOWING PAGES the author has tried to show how costs for some of the elements of a house can be analyzed and estimated. Costs given are for the sake of comparison only, and no overhead or profits are included in any of the figures, for the reason that these charges vary a great deal and, if included, would modify the advantages of any cost figures given. For costs of brick and hollow-tile walls see chapters dealing with these products.

The method adopted for setting up the tables to arrive at the costs permits the easy substitution of material prices, wage rates, and the adjustments necessary in labor costs to meet a local condition for any of these types of construction. The prices given are net prices, and they should be increased with cost for overhead and profit.

This material is taken from the author's manuscript on "Structural Design" which will be published in the near future.

ESTIMATES SIMPLIFIED

The seemingly complex matter of estimating the cost of building a house is in reality a summation of a number of unit operations. These unit operations can be analyzed rather thoroughly and correctly, as has been shown on these pages.

No attempt has been made to cover all items. Only those major parts of the construction have been treated that will vary the cost of the building for various types of construction to a considerable degree.

THE AVERAGE HOUSE

Thus the roof, wall and floor constructions have been analyzed thoroughly; and with the knowledge that the average-sized single-unit detached dwelling has about:

2,000 square feet of outside wall area,
750 square feet of floor area per story, and
950 square feet of roof area,

the effect of different constructions used in a house can easily be determined.

THE OUTSIDE WALL

Suppose we have an average frame house with walls of beveled siding, and we want to know how much more it will cost to have walls of 8-inch common brick.

The cost of the frame wall is as follows, by using estimates given in this chapter:

Cost of Frame Wall per 100 *Square Feet*

Paint	$ 4.26
Siding	11.81
Building Paper	0.90
Sheathing	8.41
Studs	5.13
Wood Lath	2.83
Plaster, 3 Coats	10.00
Cost per Square	$43.34

The cost of the 8-inch common brick wall will be: (See chapter on "Brick Construction" for cost of 8-inch brick wall.)

Cost of 8-*inch Common Brick Wall per* 100 *Square Feet*

8-inch Common Brick	$42.22
Furring and Plugging	3.01
Metal Lath	3.60
Plaster, 3 coats	12.00
Cost per Square	$60.83

Therefore, the increase in the net cost for an average house with 8-inch common brick walls instead of standard frame walls will be:

2,000 × (60.83 — 43.34) = $349.80

THE FLOORS

Similarly, the difference in cost between a standard frame floor and, for instance, the new fireproof Tilecrete floor for this average home can be obtained.

The cost of the frame floor is as follows, by using estimates derived on the following pages:

Cost of Frame Floor per 100 *Square Feet*

Oak Hardwood Flooring	$23.31
Building Paper	0.90
Underflooring	9.12
Bridging	2.67
Wood Joists (2"×10")	12.52
Wood Lath	2.83
Plaster, 3 coats	10.00
Cost per Square	$61.35

The cost of Tilecrete Slab floor has been found to be 35 cents per square foot (See chapter "Structural Clay Tile in Modern Home Construction), so therefore the total cost will be as follows:

Cost of Tilecrete Slab Floor per 100 *Square Feet*

Oak Hardwood Flooring	$23.30
Applied directly on Tilecrete Slab, allow for extra labor	10.00
Tilecrete Slab Floor	35.00
Plaster, 2 coats only	7.00
Cost per Square	$75.30

Therefore, the increase in net cost for the average home to have fireproof floors instead of ordinary frame floors will be:

750 × (75.30 — 61.35) = $105

As a conclusion, it will be found that the cost of the complete fireproof house of average size will be an increase of the price of the frame house in the following amounts:

For the Outside Walls	$349.80
" " Basement Floor	105.00
" " Second Floor	105.00
Total amount difference	$559.80

If $59.80 is paid out cash, and $500 is added to the 20-year 6% mortgage, the increased monthly payments will be only $3.63.

WOOD FRAMING COSTS

One hesitates to venture upon an analysis of wood framing costs. Not only do material prices differ in various localities but at present they vary almost from day to day in the same locality. Nor are labor rates and productions the same even in the same vicinity. At the present moment, although union scales of labor are in effect, they are not universally recognized, for many workmen are taking what they are offered.

In the following attempts to establish wood framing costs a normal average production has been used together with quoted prices for material delivered and labor priced at full union wages as per New York in March 1937.

The figures given are net costs with no allowance for overhead or profit included.

MEASURING LUMBER

Lumber is measured by the board foot and sold on a basis of 1,000 board feet, or 1,000 feet board measure. The term board measure is abbreviated B.M. Thus 1,000 feet board measure is written 1,000′ B.M. Therefore, a quantity of 3,600 board feet selling at $52.50 per 1,000 board feet would be abbreviated to 3,600′ B.M. @ $52.50 per M.

To obtain the content of a piece of lumber in board feet, multiply the width in inches by the thickness in inches by the length in feet, and divide the product by 12.

Thus a joist 2″ × 8″ and 18 feet long will contain 2 × 8 × 18 : 12 = 24′ B.M.

WASTE IN BOARDS AND PLANKS

Lumber is always charged on the bases of "rough stock" before it is planed or "dressed." When the lumber is used as a structural member only—for instance, as studs or joists—the actual dimensions are not important, as rough dimensions are used as basis for the stress design.

But in surface covering an allowance must be added for side waste due to dressing or matching in addition to the end waste due to the fact that lengths of boards may not be even multiples of the spacing of supports.

Since matching takes ¾ inch from the width of a plank, it is evident that a percentage for scant width must be added. The following table gives this allowance as well as the total allowance for scant width and waste.

Width of Board Inches	*Face Width Inches*	*Percentage to Be Added for Scant Width Only*	*Percentage to Be Added for Scant Width and Waste*
4	3¼	23.0%	30%
6	5¼	14.3%	20%
8	7¼	10.3%	18%

COST OF LUMBER

The cost of lumber depends on (1) the grade, (2) the size, and (3) the length. For certain sizes and lengths in different grades a base price per M feet board measure is used. For other grades, sizes, and lengths, amounts are added to or deducted from the base price per M feet B.M.

COST OF LABOR

When estimating labor costs, bear in mind the cost will vary with the class of work performed, with the ability of the carpenter, and with the experience of the foreman in charge. It must be understood that men will install more material per hour in large straightaway buildings than in small buildings or those that are badly cut up with numerous partitions, wings, dormers, etc.

The item on common labor includes various items, as, for instance, the labor required to carry the lumber into the building and to pile it up in convenient locations for use, or to hoist it to upper stories when the building is more than one story high.

Sometimes it is more accurate to figure the common labor as a uniform percentage of the carpenter labor. Thus, in bigger constructions it is advisable to have half as many laborers as carpenters, while in cases of small buildings badly cut up, one laborer may be able to wait on as many as ten carpenters.

NAILS

In making up an estimate it is not necessary to figure carefully the amount of nails of different sizes required but rather the number of kegs (one keg of nails weighs 100 pounds) or total weight in pounds.

The average price for nails is approximately 5 cents per pound.

Nails might be driven straight through lumber—known as "through nailing"—or they may be driven in an inclined direction—known as "toe nailing" or as "blind nailing."

Quantities of Nails for Various Material

Material	*Unit*	*Size*	*Kind*	*Lbs.*
Joists and Sills	1000′ B.M.	20d	Common	30
Studding	1000′ B.M.	10d	Common	20
Rafters	1000′ B.M.	10d	Common	20
Sheathing, Shiplap	1000′ B.M.	8d	Common	25
Bevel Siding	1000′ B.M.	6d	Common	25
Flooring, Pine	1000′ B.M.	8d	Common	30
Flooring, Hardwood	1000′ B.M.	6d	Common	30
Lath	1000 Laths	3d	Lath	10
Shingles	1000 Shingles	4d	Shingle	6

WOOD FLOOR COSTS

A wood joist floor consists of the wood joists, the bridging, the subflooring, the building paper, and the finished flooring. Underneath the floor joists (ceiling below) wood lath and two or three coats of plaster with hard white finish are applied if required.

The wood joists are the carrying members, and upon their strength the whole floor construction depends. The joists are, as a rule, spaced 16 inches on centers. The size varies in accordance with the load carried and the span.

With a 40-pound live load and 16-inch spacing the following sizes of joists are recommended:

	Board Feet per Linear Ft.	*Board Feet per Square Ft.*
12-foot span use 2″×8″	1.33	1.00
14-foot span use 2″×10″	1.66	1.26
16-foot span use 2″×10″	1.66	1.25
18-foot span use 3″×10″	2.50	1.88

For an ordinary floor construction 2″×8″ wood joists are used. By using the heavier size, 2″×10″, the strength is increased considerably, while the increase in cost is small.

WOOD JOISTS 2″×8″

A waste of 20% is assumed, so the total number of board feet per 100 square feet of floor area will be 120′ B.M. The price in New York is $50 per M feet B.M.

Cost per 100 Square Feet

120′ B.M. @ $0.05	$6.00
Nails, 120×0.03×0.05	0.18
Carpenter, 120×0.018×1.40	3.25
Helper, 120×0.005×0.825	0.50
Cost per Square	$9.93

WOOD JOISTS 2″×10″

A waste of 20% is assumed, so the total number of board feet per 100 square feet of floor area will be 150′ B.M. The price in New York is $52.50 per M feet B.M.

Cost per 100 Square Feet

150′ B.M. @ $0.0525	$7.89
Nails, 150×0.03×0.05	0.23
Carpenter, 150×0.018×1.40	3.78
Helper, 150×0.005×0.825	0.62
Cost per Square	$12.52

BRIDGING

Gross bridging is composed of diagonal pieces, usually 1″ by 3″, nailed to form an X pattern and arranged in rows at right angles to the joists. They provide a means of stiffening the floors and distributing the load.

On the assumption that there are 3 linear feet of 1″×3″ to each set of bridging, and that each set is spaced 6 feet on centers, there will be 0.5 linear feet of bridging for each foot of joist. Material per square foot will therefore be 0.5×¾= 0.375 linear feet. If a waste of 25% is assumed, the material required per 100 square feet will be 37.5 + 9.4 = 46.9 linear feet.

It is assumed that 30 hours are required for cutting and nailing in place 1000 linear feet of 1″×3″ bridging, and that the cost is $9.00 per 1000 linear feet of 1″×3″ lumber.

Cost per 100 Square Feet

46.9 linear feet of 1″×3″@0.09	$0.43
Nails, etc.	0.10
Carpenter, 46.9×0.030×1.40	1.98
Helper, 46.9×0.004×0.825	0.16
Cost per Square	$2.67

UNDERFLOORING

Underflooring is a wood floor—also called subfloor, usually of matched 1″×6″ lumber which is laid over the floor joists. The subfloor is covered with building paper. A matched board is edge-dressed and shaped to make a close tongued and grooved joint at the edges.

The finished width of a 6-inch matched board is 5¼ inches. Thus, here is a waste of 14.3% in the material.

Cost per 100 Square Feet

120′ B.M. @ $0.375	$4.50
Nails, 120×0.03×0.05	0.18
Carpenter, 120×0.024×1.40	4.04
Helper, 120×0.004×0.825	0.40
Cost per Square	$9.12

BUILDING PAPER

Before laying the finish floor the subfloor should be covered with a layer of heavy coated building paper. A waste of 20% is assumed as well as a labor cost of half the cost of the paper.

Cost per 100 Square Feet

120 square feet of building paper @ $0.005	$0.60
Labor, half of above	0.30
Cost per Square	$0.90

FINISH FLOORING

The finish floor provides the wearing surface over the subfloor. Both hardwoods and softwoods are used, as well as various composition materials.

The prices vary in accordance with the material used, but it can be assumed that a good oak flooring, including staining and waxing, will cost from $17 to $28 per square.

In the manufacturing of flooring a great percentage of the material is lost in forming tongue and groove. For the most common flooring board having a 2¼ inch face, a 3-inch strip of boarding is required. Therefore, there is a loss of 33⅓%, as the board is sold as a 3-inch board. In addition an allowance of at least 5% must be made for waste. Therefore, it is a safe practice to use a total allowance of 39% in the material estimate.

After the floor has been laid, the surface must be planed and scraped in order to remove all projecting parts, and sanded to produce a smooth surface that can be properly finished. Approximate cost is 3 cents per square foot.

Cost per 100 *Square Feet*

Oak, plain, 139′ B.M. @ $0.11	$15.30
Nails, 139×0.03×0.05	0.21
Carpenter, 3 hours @ 1.40	4.20
Scraping and sanding, 100×0.03	3.00
Covering with building paper	0.60
Cost per Square	$23.31

THE FINISH OF THE FLOOR SURFACE

The staining and waxing of the floor is an important process. It will include an application of a paste filler and the removing of the surplus of it, a coat of shellac, a sanding, a coat of wax, sanding again, and a second coat of varnish, and sometimes a rubbing down to an eggshell finish.

The cost for this work will vary from 2 cents to 7 cents per square foot.

FRAME WALL CONSTRUCTION COSTS

The frame wall consists of studs, sheathing, building paper and finished siding.

THE STUDS

The studs are the closely spaced vertical members in the wall. Their purpose is to support the weight of the upper floors and to provide a framework for sheathing and finish on the outside and lath and plaster on the inside. The standard size is 2″×4″ with a spacing of 16 inches. However, for buildings over three stories high, the studs in the lower story should be 3″×4″ or 2″×6″.

A stud 2″×4″ contains ⅔ board feet. As the studs are spaced 16 inches on centers, there will be ¾ studs per foot width. With a waste of 20% assumed, there will be 0.6′ B.M. per square foot of wall area. The cost of studs is $45 per M feet B.M. in New York.

Cost per 100 *Square Feet*

60′ B.M. @ $0.045	$2.70
For bracing, add 10%	0.27
Nails, 60×0.02×0.05	0.06
Carpenter, 60×0.022×1.40	1.85
Helper, 60×0.005×0.825	0.25
Cost per Square	$5.13

THE SHEATHING

The sheathing is nailed directly on the framework and forms a base upon which the finish siding may be nailed. A waste of 20% is assumed. The cost of 1″×6″ matched lumber is now $37.50 per M feet B.M.

Cost per 100 *Square Feet*

120′ B.M. @ $37.50	$4.50
Nails, 120×0.025×0.05	0.15
Carpenter, 120×0.020×1.40	3.36
Helper, 120×0.004×0.825	0.40
Cost per Square	$8.41

BUILDING PAPER

Building paper should be introduced between the sheathing and the outside finish to prevent the passage of air through the walls.

A heavy coated building paper is used. A waste of 20% as well as a labor cost of half the cost of the paper is assumed.

Cost per 100 *Square Feet*

Material 120 square feet @ $0.005	$0.60
Labor 50% of above	0.30
Cost per Square	$0.90

THE SIDING

The outside layer of boards which forms the weather-resisting surface of a frame wall is known as siding. The commonly used forms of siding are novelty and bevel siding.

NOVELTY SIDING

Novelty siding comes in boards 1″×6″, and is laid 5¼ inches to the weather, so there is a waste of 20%.

Cost per 100 *Square Feet*

120′ B.M. @ $0.52	$6.24
Nails, 120×0.03×0.05	0.18
Carpenter, 120×0.017×1.40	2.85
Helper, 120×0.004×0.825	0.40
Cost per Square	$9.67

BEVEL SIDING

With the use of ½″×6″ bevel siding there is a waste of 43%.

Cost per 100 *Square Feet*

143′ B.M. @ $0.052	$7.44
Nails, 143×0.25×0.05	0.18
Carpenter, 143×0.018×1.40	3.60
Helper, 143×0.005×0.825	0.59
Cost per Square	$11.81

PAINT

There is required 0.8 of a gallon of paint to cover 100 square feet, and it will take a painter 1.9 hours to apply this paint in three coats.

Cost per 100 *Square Feet*

Paint, 0.8×$2.00	$1.60
Painter, 1.9×$1.40	2.66
Cost per Square	$4.26

ROOF CONSTRUCTION COSTS

A framed roof consists of wood rafters spaced 16 inches on centers, covered with 1 inch sheathing, weather proofing and the shingles.

For an ordinary roof 2″×8″ wood rafters are used. By using 2″×10″ wood rafters, the strength of the roof is increased considerably, while the increase in cost is only about 3 cents per square foot.

WOOD RAFTERS 2″×8″

The material is measured in board feet; 1 board foot equal to a piece of wood 1 foot long, 1 foot wide and 1 inch thick. The price today for 1,000 board feet 2″×8″ and 2″×10″ of normal length in New York is $50 and $52.50 respectively.

As the spacing is 16 inches, or 4/3 foot, there are ¾ joist on each foot width.

A 2″×8″ board contains 2×8÷12=4/3 board feet, so material per square foot, therefore, will be 4/3×¾=1.00 board foot and, if a waste of 20% is assumed, the total of material required for 100 square feet will be 120 board feet.

On roof framing it is assumed that twenty-four hours are required to frame 1,000 board feet. The wage to a carpenter is $1.40 per hour.

Cost per 100 *Square Feet*

120′ B.M. @ $0.05	$6.00
Nails, 120×0.02×0.05	0.12
Carpenter, 120×0.024×1.40	4.04
Helper, 120×0.006×0.825	0.60
Cost per Square	$10.76

WOOD RAFTERS 2″×10″

Material per square foot will be 2 × 10 ÷ 12 × ¾ = 1.25 board feet and, if a waste of 20 per cent is assumed, the total of material required per 100 square feet is 125+25=150 board feet.

Cost per 100 *Square Feet*

150′ B.M. @ $0.0525	$7.89
Nails, 150×0.02×0.05	0.15
Carpenter, 150×0.024×1.40	5.04
Helper, 150×0.006×0.825	0.75
Cost per Square	$13.83

THE SHEATHING

Using 1″×6″ dressed and matched material and assuming 20% waste, we get 120 board feet per 100 square feet. The cost of 1″×6″ material is $37.50 per 1,000 board feet.

On matched sheathing it is assumed that twenty hours are required to lay 1,000 board feet.

Cost per 100 *Square Feet*

120′ B.M. @ $0.0375	$4.50
Nails, 120×0.02×0.05	0.12
Carpenter, 120×0.02×1.40	3.36
Helper, 120×0.005×0.825	0.50
Cost per Square	$8.48

THE WEATHERPROOFING

As weatherproofing, saturated felt or electro sheet copper may be used. In this connection it may be noted that many buildings today are erected without weatherproofing.

Felt is furnished in rolls and the price varies. It pays to use a good quality like Vitex Roofing, which comes in rolls of 108 square feet to cover 100 square feet. The price is $2.00 per roll delivered. It will take two men one half-hour to lay 400 square feet. The wage for a roofer is $10.28 for an eight-hour day, or $1.29 per hour.

Cost per 100 *Square Feet*

Material, one roll Vitex Roofing	$2.00
Labor, 2 × ½ × 1.29 × ¼	.32
Nails, etc.	.25
Cost per Square	$2.57

Electro sheet copper (1 ounce) is also furnished in rolls. The price fluctuates somewhat and is today $4.80 per roll of 100 feet by 30 inches wide. This corresponds to $1.92 cents per square foot. There is a waste of 20% and it takes two men one half-hour to lay 200 square feet. To make a good job, the copper should be cemented to the sheathing. For this purpose Liquid Elastigum is recommended. It will remain elastic and will close holes around the nails used for the shingles. One gallon, costing 50 cents, will cover 75 square feet and it will take one man one half-hour to cover 100 square feet with it.

Cost per 100 *Square Feet*

Material, 120 sq. ft. copper at 1.92 cents	$2.31
1.5 gals. Liquid Elastigum	.75
Labor, 2 × ½ × 1.29 × ½ (copper)	.65
1 × ½ × 1.29 (Elastigum)	.64
Cost per Square	$4.35

ASPHALT SHINGLES

There are two distinctly different types of shingles; strip-shingles and unit-shingles. While a good many of the unit-shingles are slightly higher in price, the prices for both vary between $5.00 and $12 per square.

It takes two men 1.4 hours to lay one square of Massive Square-tab Strip-shingles and 2.0 hours to lay one square of Massive Unit-shingles. The wage of a roofer (composition shingles) is $10.28 per an eight-hour day, or $1.29 per hour.

Massive Square-tab Strip-shingles 10″

Material, one square	$7.17
Labor, 2 × 1.4 × 1.29	3.62
Nails, etc.	.50
Cost per Square	$11.29

Massive Units, Unit-shingles

Material, one square	$10.69
Labor, 2 × 2 × 1.29	5.16
Nails, etc.	.45
Cost per Square	$16.30

ASBESTOS SHINGLES

These shingles can be obtained at various prices. The price for the popular 8″×16″ American Method Asbestos Cement Shingle (made by Ruberoid) is $14.82 per square. It takes two men three hours to lay one square.

Cost per 100 *Square Feet*

Material, one square	$14.82
Labor, 2 × 3 × 1.29	7.74
Nails, etc.	.40
Cost per Square	$22.96

THE COST OF CONCRETE

The cost of concrete will vary between fairly wide limits in different parts of the country. Where some cities pay $3.00 per cubic yard of stone, it may sometimes be secured on country jobs as low as 60 cents. The price of cement varies considerably and the labor cost is subject to great variations. Many other factors, including plant, size of job, number of stories, contracting ability, weather and working conditions, and labor rules contribute to the variation in the cost of concrete.

I have, therefore, given the quantitative computation of the cost of concrete with certain assumed average unit prices that I have found exist in the vicinity of New York. The engineer may compute for himself with little trouble the local price differential for the conditions under which he must operate.

THE CONCRETE MIXER

Practically all concrete used in house construction should be mixed by machine. Concrete mixers have now been brought to a high state of efficiency, producing satisfactory results at a minimum cost of labor and power.

The mixer should be of the batch type, having a capacity at least large enough to take one sack-batch of 1:3:5 concrete. A mixer of this size will take a one-sack or a one-and-a-half-sack batch of 1:2:4 mixture. However, it is well to avoid when possible a split sack-batch, since using part of a sack leads to inaccuracies in proportioning.

THE COST OF MAKING CONCRETE

With an average time for each batch of three minutes, the output for an eight-hour day will be 26.4 cubic yards. Each batch gives 0.166 cubic yards of 1:2:4 concrete, and 160 batches can be turned out in one day. As the material is delivered alongside the mixer, only a mixer foreman and one helper are required.

The cost of making 26.4 cubic yards of concrete will be

1 mixer foreman, 8 hrs. at $1.50	$12.00
1 helper, 8 hrs. at 75 cents	6.00
Overhead per day	4.00
Total Cost	$22.00

Therefore, the cost of making one cubic yard will be 84 cents.

THE COST OF PLACING CONCRETE

For placing concrete a wheelbarrow is generally used. The ordinary load should be two cubic feet of concrete, but is found to be only 1.7 cubic feet.

One man can make, on an average, ten trips per hour, and thus place 17 cubic feet per hour on the first-floor level. For the second-floor and roof levels the corresponding capacities are 14 and 11 cubic feet, respectively.

Using an average of 14 cubic feet per hour placed and with an hourly wage of 75 cents, the average cost per cubic foot will be 5.4 cents, or $1.45 per cubic yard.

THE COST OF 1:2:4 CONCRETE

The proper and most common mixture of concrete is 1:2:4, which means one volume of cement, two volumes of sand, and four volumes of stone. This mixture is used in ordinary walls, floors, beams and slabs, etc.

To make one yard, there are required

6.04 sacks of cement at 66 cents	$3.99
0.45 cubic yds. of sand at $2.00	.90
0.89 cubic yds. of stone at $2.50	2.22
Cost of Material Only	$7.11

If the cost of making the concrete (84 cents per cubic yard) is added to this price, we obtain the total cost of concrete at the job to be $7.95 per cubic yard, or 29.5 cents per cubic foot. Ready-mixed concrete can today be obtained at $8.00 per cubic yard in the vicinity of New York.

THE COST OF 1:2:3 CONCRETE

Sometimes it is required to have a concrete that must withstand water pressure—for instance, in basement walls in wet grounds. If that is the case, a mixture of 1:2:3 should be used.

To make one yard, there are required

6.96 sacks of cement at 66 cents	$4.60
0.52 cubic yds. of sand at $2.00	1.04
0.77 cubic yds. of stone at $2.50	1.93
Cost of Material Only	$7.57

If the cost of making the concrete (84 cents per cubic yard) is added to this price, we obtain the total cost of concrete at the job to be $8.41 per cubic yard, or 31.1 cents per cubic foot.

THE COST OF 1:3:5 CONCRETE

In foundations, sidewalks, steps, driveways, etc., a leaner mixture, as for instance 1:3:5, may be used.

To make one yard, there are required

4.65 sacks of cement at 66 cents	$3.06
0.52 cubic yds. of sand at $2.00	1.04
0.86 cubic yds. of stone at $2.50	2.15
Cost of Material Only	$6.25

If the cost of making the concrete (84 cents per cubic yard) is added to this price, we obtain the total cost of concrete at the job to be $7.09 per cubic yard, or 26.3 cents per cubic foot.

THE WATER-CEMENT RATIO LAW

Lately it has been found that the mixtures just given are not the most economical, though they are commonly used. It has been proven that the design of concrete mixtures shall be based upon the relationship between the properties of the hardened concrete and the amount of mixing water used.

The strength and other desirable properties of concrete—flexural and tensile strength, resistance of concrete to wear, and the bond between concrete and steel—are governed by the quantity of water used per sack of cement.

The prices for water-cement-ratio mixes are given here as suggested by Portland Cement Association. As the author knows these mixtures well, it is suggested that architects and builders specify these new mixtures in their specifications, as they can rely completely on the authority of the above-mentioned association.

THE COST OF 1:1¾:2 CONCRETE

This concrete is called Five Gallon Heavy Duty Floor Mix and is used extensively where the concrete is exposed to heavy wearing.

To make one yard, there are required

8.00 sacks of cement at 66 cents	$5.28
0.52 cubic yds. of sand at $2.00	1.04
0.60 cubic yds. of stone at $2.50	1.50
Cost of Material Only	$7.82

If the cost of making the concrete is added to this price, we obtain the total cost of concrete at the job to be $8.66 per cubic yard, or 32 cents per cubic foot.

THE COST OF 1:2¼:3 CONCRETE

This concrete is called Six Gallon Water-Tight Concrete and is used in foundation walls, walks, drives, etc.

To make one yard, there are required

6.25 sacks of cement at 66 cents	$4.13
0.52 cubic yds. of sand at $2.00	1.04
0.70 cubic yds. of stone at $2.50	1.75
Cost of Material Only	$6.92

If the cost of making the concrete is added to this price, we obtain the total cost of concrete at the job to be $7.76 per cubic yard, or 28.7 cents per cubic foot.

THE COST OF 1:2¾:4 CONCRETE

This concrete is called Seven Gallon Mass Concrete and is used in places not exposed to the weather.

To make one yard, there are required

5.00 sacks of cement at 66 cents	$3.30
0.52 cubic yds. of sand at $2.00	1.04
0.74 cubic yds. of stone at $2.50	1.85
Cost of Material Only	$6.19

If the cost of making the concrete is added to this price, we obtain the total cost of concrete at the job to be $7.03 per cubic yard, or 26 cents per cubic foot.

FIREPROOF FLOORS

The following statements represent average conditions in the New York district. These statements must be taken with the understanding that costs vary greatly—even on two adjacent buildings. The types described are either fireproof or highly fire-resisting.

The unit costs I have used in the following estimates are as follows:

Concrete in place—35 cents per cubic foot. 1:2:4 mixture.

Material Cost	26.3
Fabrication Cost	3.1
Placing Cost	5.4
Total Cost	34.8 cents

Wood formwork, erected and removed—18 cents per square foot.

Reinforcing bars placed—4.5 cents per pound.

Wire fabric and stirrups placed—5.5 cents per pound.

4″ × 12″ × 12″ tile block cost $9.00 and labor $2.00 per 100 blocks.

THE SOLID CONCRETE SLAB

A slab 6 inches thick is generally suitable for spans up to 14 feet in length. Reinforcing consists of ⅝ inch bars spaced 8 inches on centers, weighing 1.58 pounds a square foot. Wire fabric weighing 25 pounds per 100 square feet, is used instead of temperature bars.

The cost per 100 *square feet of 6-inch concrete slab will therefore be*

Concrete, 0.5 × 100 × 0.35	$17.50
Reinforcement, bars, 158 × 0.045	7.10
fabric, 25 × 0.055	1.38
Forms, 100 × 0.18	18.00
Total Cost	$43.98

Similarly, the prices may be obtained for other thicknesses of slabs. Thus the prices will be for a:

2½-inch	slab	29.5	cents	per	square foot
4 -inch	slab	35.3	cents	per	square foot
5 -inch	slab	39.6	cents	per	square foot
6 -inch	slab	44	cents	per	square foot

In above prices the cost of 18 cents per square foot for forms is included. The mixture is 1:2:4.

This construction gives a flat ceiling below, and the cost of plastering this will be about 7 cents per square foot. Only two coats are required.

THE RIBBED FLOOR CONSTRUCTION

In the construction of ribbed concrete floors, joists not less than 4 inches wide and 6 inches deep are recommended for spans up to 16 feet in length.

Reinforcing consists of two ⅝ inch rods, weighing 2.10 pounds per foot. Wire fabric weighing 24 pounds per 100 square feet is used instead of temperature bars.

The cost per 100 *square feet will therefore be*

Concrete, 0.25 × 100 × 0.35	$8.75
Reinforcement, rods, 2.10 × 10 × 5 × 0.045	4.73
fabric, 25 × 0.055	1.38
Forms, 100 × 0.20	20.00
Total Cost	$34.86

Thus the cost per 1 square foot of ribbed floor construction will be 34.9 cents. It will be noted that the cost for forms has been increased to 20 cents on account of the ribbed construction.

This construction gives the effect of a beamed ceiling below.

If a flat ceiling is required, ¾ inch plaster on metal lath should be used. The cost is about 18 cents per square foot. In this price 6 cents are figured for the metal lath in place.

CLAY TILE AND CONCRETE JOIST

This type of floor consists of a combination of hollow tile, size 4″ × 12″ × 12″, and reinforced concrete joists spaced 16 inches on centers. Joists not less than 4 inches wide and 4 inches deep, with a top slab not less than 2 inches thick, are recommended for spans up to 13 feet in length. The amount of concrete equivalent to 0.25 cubic feet per square foot.

Reinforcement consists of one ¾ inch round rod per joist, weighing 1.52 pounds per foot. Wire fabric weighing 25 pounds per 100 square feet is used instead of temperature steel.

The cost per 100 *square feet will therefore be*

Clay Tile Blocks, 75 × 0.11	$8.25
Concrete, 0.25 × 100 × 0.34	8.75
Reinforcement, rods, 1.52 × 10 × ¾ × 0.045	5.13
fabric, 25 × 0.055	1.38
Forms, 100 × 0.14	14.00
Total Cost	$37.51

Thus the cost per one square foot will be 37.5 cents. It will be noted that the cost for forms has been put at 14 cents per square foot, because the forms need not be very tight.

This construction gives a flat ceiling below. A two-coat plastering is sufficient for this type of ceiling. The cost for plastering is approximately 7 cents per square foot.

JUNIOR BEAM CONCRETE FLOOR SYSTEM

Herewith an attempt is going to be made to derive a reasonable cost figure for average ideal conditions. We will consider a panel 14 feet wide and 32.5 feet long. The system is composed of three parts: the steel beams, the forms, and the reinforced concrete slab.

THE STEEL BEAMS

In the above case either 8-inch or 9-inch Junior Beams, weighing 6.5 and 7.5 pounds per foot respectively, are used, spaced 39 inches on center, this particular spacing accommodating the total width of five 8-inch boards. There are, therefore, 0.31 beams per 1-foot width.

As the steel beams are ordered to length from the mill, the erection will be very simple. It has been found that two men can erect 750 pounds of steel beams per hour. The union wage to a structural iron worker is $1.65 per hour, so the cost of the erection will be 2×1.65÷750=0.44 cents per pound. The cost of the steel beams delivered, punched and cut to length, within 25 miles of New York, is $4.25 per hundred pounds.

THE CONCRETE FORMS

In this system the Junior Beams themselves carry the forms. Vertical boards or spreaders (6″ × 1″), spaced 30 inches apart and spanned between the beams and resting on the bottom flanges of the beams, carry the 8″ × 1″ form boards. Only enough nails to keep the spreaders in position are necessary in this form.

On a panel 10′ × 10′ there are three rows of spreaders with a total length of 30 feet. With a waste of 20% the total will be 36 lineal feet of 6″ × 1″ boards, or the equivalent of 18 board feet. The form boards for this panel of 100 square feet with an assumed waste of 20% will take 120 board feet, and, if the spreaders are included, a total of 138 board feet are required for this area.

It can safely be assumed that the forms can be used three times, so the consumption each time will be 46 board feet. There are 16 hours required for cutting and fitting 1,000 board feet, and 10 hours to place and strip 1,000 board feet.

Cost of forms per 100 *Square Feet*

46′ B.M. @ $0.0375	$1.73
Nails, etc.	0.25
Carpenter, 138 × 0.026 × 1.40	5.03
Helper, 138 × 0.013 × 0.825	1.47
Cost per Square	$8.48

THE CONCRETE SLAB

The concrete slab is usually 2½ inches thick and the reinforcing shall be ¼ inch steel pencil rods spaced 6 inches on centers. Temperature reinforcement shall be ¼ inch steel pencil rods spaced 18 inches on centers and placed at right angles to main reinforcement. The cost of a 2½ inch reinforced concrete slab is placed at 11.5 cents per square foot, forms not included.

THE COST OF THE JUNIOR BEAM CONCRETE FLOOR SYSTEM

For ordinary loads 8-inch beams are sufficiently strong to carry a floor spanning up to 14 feet. However, as the following tables will show that the cost of a 9-inch beam floor system is only 1.5 cents more per square foot, it is recommended to use the bigger beam whenever the span is more than twelve feet.

8-*Inch Junior Beam Concrete Floor System*

2½″ concrete slab	11.50 cents
Forms	8.48
Steel, 6.5 × 0.31 × 4.25	8.56
Steel (erection) 2.01 × 0.44	0.89
Cost per One Square Foot	29.43 cents

9-*Inch Junior Beam Concrete Floor System*

2½″ concrete slab	11.50 cents
Forms	8.48
Steel 7.5 × 0.31 × 4.25	9.85
Steel (erection) 2.32 × 0.44	1.02
Cost per One Square Foot	30.85 cents

This floor system is now ready for the finished flooring to be set in mastic. It may be hard wood, wood parquet, linoleum, tile or terrazzo. As the concrete is floated smooth at the time of the pouring, it requires no separate finish to receive the mastic.

It will be noted that the beams are not fireproofed, nor has plaster been applied on the underside of the slab.

LATH AND PLASTER

FURRING

On masonry walls the lath shall be furred if possible. This is done by the use of furring strips, mostly 1″ × 2″ wood furring strips.

For ordinary workmanship, with the strips following the line of wall without wedging and blocking out to make them straight or plumb, and with the nails driven into dry joints in the brick work, a carpenter should place 1,000 linear feet of furring strips in 14 hours.

Where it is necessary to plug the walls and place all furring strips straight and plumb to produce a level surface to receive lath and plaster, a carpenter will require 40 hours to place 1,000 linear feet of furring strips. One helper will take care of two carpenters.

As the furring strips are spaced 16 inches on centers, there will be ¾ foot of furring strip per one square foot of wall area. The cost in New York is 7.5 cents per linear foot of 1″ × 2″ strips. A waste of 20% is assumed.

Cost per 100 *Square Feet of Wall Area*

90 linear feet 1″ × 2″ @ $0.075	$0.68
Nails	0.05
Carpenter, 90 × 0.014 × 1.40	1.76
Helper, 90 × 0.007 × 0.825	0.52
Cost per Square	$3.01

LATH

Lath provides the base for plaster. Either wood lath or metal lath may be used.

Wood laths are manufactured in 48-inch lengths, 1½ inch wide and ⅜ inch thick. They are put up in bundles of 100 and sold by the thousand at about $8.00 per 1,000 pieces. The spacing is approximately ½ inch. For 100 square feet 160 laths are used and approximately 1 pound of lathing nails. A lather can apply 160 laths in one hour when the standard spacing of 16 inches is used.

Cost of Wood Lath per 100 *Square Feet*

160 laths @ $0.008	$1.28
Nails, 1 pound @ $0.05	0.05
Lather, 1 hour @ $1.50	1.50
Cost per Square	$2.83

Metal lath is made from sheet metal that has been cut and expanded into a mesh. Wire lath is wires electrically welded together, often backed with a building paper. The lath is stapled in place with galvanized wire staples.

The cost of wire lath is approximately 18 cents per square yard, and there are 9 hours required to apply 100 square yards.

Cost of Metal Lath per 100 *Square Feet*

105 square feet @ $0.02	$2.10
Nails, 0.6 pound @ $0.05	0.03
Labor, 1 hour @ $1.50	1.50
Cost per Square	$3.63

PLASTER

Plaster is a mixture of sand or other fine aggregates with a binder of lime, gypsum (plaster of Paris) or cement, and hair and fiber. The customary method of application on a wood or metal lath base is to apply it in three coats. These coats consist of scratch coat, brown coat, and finish or skim coat. When applied to masonry walls the scratch coat is omitted.

Costs per Square Foot (approximately)

3 coats plaster on wood lath	$0.10
3 coats plaster on metal lath	0.12
2 coats plaster on masonry	0.07

The Cost of an INSURED MORTGAGE

● TO ILLUSTRATE the preparation and execution of the forms and instruments in connection with loans to be submitted for insurance under Title II of the National Housing Act, and to show the method of computing the amounts and dates described therein, the following case has been assumed:

Type of transaction.—The mortgagor desires to obtain a loan in connection with the purchase of a dwelling, the purchase price of which is $5,400.

Amount of loan desired.—$4,100. (As a matter of policy all loans will be in multiples of $100.) It is assumed that this amount would not exceed 80 per cent of the appraised value of the property and that the mortgagor has sufficient funds available for a cash down-payment of $1,300 plus the adjustments and closing charges.

Rate of interest.—The rate of interest in this case is 5 per cent. (Under the Administrative Rules and Regulations of the Federal Housing Administration any rate of interest may be charged up to the maximum rate of 5 per cent.)

Amortization period.—The mortgagor and mortgagee agree that the loan should be amortized over a period of 19 years or in 228 equal monthly installments of principal and interest.

Taxes.—Annual taxes for the year ending May 1, 1936, due and payable on the same date, were in the amount of $75. It is estimated that the taxes due May 1, 1937, will be in the same amount.

Assessments.—$45 payable in three annual installments of $15 each. The first installment of $15 will be due May 1, 1937.

Hazard insurance (fire, tornado, etc.).—Policies to protect the property were written November 18, 1935, and a total premium of $60 paid covering a period of 3 years. This is equivalent to a premium of $20 per year.

Date of disbursement.—It is expected that the closing of the loan will take place sometime in July 1936, at which time disbursement will be made.

From the foregoing facts the following pages will illustrate the preparation and execution of the forms, together with the computations, based on the use of the appended tables, in connection with handling a loan for insurance from the preliminary negotiations through closing.

COMPUTATION OF TOTAL MONTHLY PAYMENT

On the reverse side of the Mortgagors' Property Description, which is part of the Mortgagee's Application for Insurance, will be found instructions for computing the total monthly payment shown in the preliminary Application for Loan and the Mortgagee's Application for Insurance. The following explanation of the calculation of the first total monthly payment for this illustrative case is based on these instructions.

1. *Payment to principal and interest.*—This figure may be computed by referring to the amortization table, giving the dollars and cents of this payment per $1,000 of mortgage principal for various amortization periods and at various rates of interest. The factor in this case under the head of 5 per cent interest for an amortization period of 19 years is $6.81. The number of thousands of dollars of mortgage principal is 4.1. The product of these two figures (4.1 times $6.81) gives the monthly payment to principal and interest of $27.92

2. (a) *Taxes.*—Monthly installment equals one twelfth of $75 . . . . 6.25

(b) *Assessments.* — Monthly installment equals one twelfth of $15 . . . . 1.25

3. *Hazard insurance.*—$60 for 3 years or $20 for 1 year. Monthly installment equals one twelfth of $20 . . . . 1.67

4. *Service charge.*—Under the head of 5 per cent interest for an amortization period of 19 years this charge is $0.41 per $1,000. Therefore, the service charge in this case will be $0.41 times 4.1 . . . . . . 1.68

NOTE.—These factors are approximate and may give a charge differing slightly from that shown on the Amortization Schedule.

5. *Mortgage insurance premium.*—One half per cent of $4,100 equals $20.50 per year. Monthly installment equals one twelfth of $20.50 . . . . 1.71

TOTAL MONTHLY PAYMENT $40.48

APPLICATION FOR INSURANCE

When the preliminary arrangements have been completed to the satisfaction of the mortgagor and mortgagee, the Mortgagee's Application for Insurance, and the Mortgagors' Property Description, should be completed in triplicate and properly executed.

The completed forms should be submitted in duplicate to the Insuring Office together with other items as outlined in the instructions on the reverse side of the Mortgagor's Property Description, and an examination fee for the amount of $3 per $1,000 of the principal amount of the loan, but in no event for an amount less than $10. Acceptable funds are cash, postal money order, mortgagee's check or individual's check if certified. In this case the fee is $12.30.

PREPARATION OF THE CREDIT AND SECURITY INSTRUMENTS

It is assumed that this application has been approved by the Federal Housing Administration and that a Commitment for Insurance on this loan containing the following provisions was issued to the lending institution on June 2, 1936: 1. Amount, $4,100. 2. Amortization period, 19 years. 3. Rate of interest, 5 per cent. 4. 228 installments of $27.92.

For this illustrative case the standard Federal Housing Administration forms for use in the state of Illinois have been used. The forms for other states will differ in detail but the principles embodied in this example hold in general for all approved credit and security instruments.

Amount of loan, $4,100.—This agrees with the Commitment for Insurance.

Rate of interest, 5 per cent.—This agrees with the Commitment for Insurance.

Monthly payment to interest and principal, $27.92.—This agrees with the Commitment for Insurance.

First monthly payment date.—The commitment provides the following limitations on the date which may be selected for the first payment:

1. It must be on the first day of a month.

2. It may not be later than 60 days after final disbursement, except that:

3. It may be within 30 days after expiration of the commitment.

In this case the commitment was issued June 2 and will expire August 2. Under limitations 1 and 3 above the first payment may be due on September 1.

In this case disbursement is to be made sometime in July; consequently, September 1 remains the last possible date for the first payment. However, if disbursement were made in August, October 1 could be selected as the date of first payment.

The amortization period specified in the commitment always includes the month preceding the date of the first payment; consequently the first payment always includes interest in full for the preceding month. Therefore, if August 1, instead of September 1, were selected as the date of first payment, it would be necessary to refund the unearned interest from July 1 to the date of disbursement.

In this case September 1 is selected as the date of the first payment.

Maturity date.—The standard FHA forms of instruments for some states, including the state of Illinois, do not provide for an expressed maturity date. Where such expressed maturity is required it is determined as follows:

> In this case the first payment is made September 1, 1936. The amortization period, therefore, begins August 1, 1936, and ends 19 years later on August 1, 1955, which is the maturity date. One of the following tables will show the day of the year of the first payment and the corresponding day of the year of maturity. Table I is for an amortization period of any number of full years. Table II is for an amortization period of 19 years 6 months only. Since in this case the amortization period is for a number of full years, Table I is applicable. This table shows that for a first payment date of September 1, the corresponding maturity date is August 1. The maturity date, August 1, is shown in CAPITAL LETTERS in this table. The year of maturity is, therefore, obtained by adding the 19 years of the amortization period to the year of the first payment date. The maturity year is 1955.

Execution.—With the above facts determined, the security and credit instruments are prepared and executed on July 13, 1936.

The *term* (do not confuse *term* with *amortization period*) of the mortgage in this case is from the date of execution, July 13, 1936, to the date of maturity, August 1, 1955, or 19 years and 18 days. This is within the legal limit of twenty years established by the National Housing Act.

CLOSING ADJUSTMENTS AND CHARGES

At the time of closing a loan the following amounts are to be collected either in cash or from the proceeds of the loan. The purpose of making these adjustments of mortgage insurance premium, taxes, assessments, ground rents, fire and other hazard insurance at the time of closing the loan is to make certain, because of the monthly payment of these items, that the lending institution will have collected through these monthly payments sufficient funds to pay the charges at the time they become due. Actually the collection of these funds will be completed prior to their due date.

In order to accomplish this, the monthly installments of the above items are paid in advance; i. e., on September 1 the applicant will pay an amount on each of these items that will accrue during the month of September instead of paying for the amount that has become due during the month of August. Thus, in this case, by making the adjustment of taxes and having them paid in full up to the date of the first payment, the installment of taxes that will be paid on April 1 will cover the month of April, and the lending institution will then have collected $75 to pay the tax bill on May 1.

I. *Adjustments.*—The computations for the various items to be adjusted for this case are as follows:

1. Liens .... None.

2. Taxes.—The amount that will have accrued or become payable from May 1, 1936, to the first monthly payment date, September 1. May 1 to September 1 is 4 months. Four twelfths of $75 .... $25.00

3. Assessments.—The amount that will have accrued or become payable from May 1, 1936, to the first monthly payment date, September 1. May 1 to September 1 is 4 months. Four twelfths of $15 .... 5.00

4. Hazard insurance.—The amount that will have accrued or become payable from November 18, 1935, to the first monthly payment date, September 1. (These accruals apply to the payment of the next premium on November 18, 1938.) November 18, 1935, to September 1, 1936, is 9 months and 12 days, and at the rate of $20 per annum amounts to 15.67

5. Mortgage insurance premium.—This is payable annually in advance. In addition to one year's premium the first installment of the accrual of this premium for the next year should be collected.

One-half per cent of $4,100	$20.50
One twelfth of $20.50	1.71
	22.21

Note.—When more than 30 days intervenes between the date of endorsement of the loan by the Federal Housing Administration and the date of the first monthly payment, it is advisable that the mortgagee collect an additional monthly installment of this premium each first of the month up to the date of the first payment in order that he will have sufficient funds on hand to meet the next bill for the Annual Mortgage Insurance Premium when it becomes due.

6. Simple interest from disbursement date July 21 to August 1 on $4,100 at the rate of 5 per cent per annum 5.69

Total Adjustments $73.57

II. *Closing charges:*

1. Cost of title search	$30.00

Note.—This must be reasonable and in line with local practice.

2. Recording or filing fees or charges ...	3.75

Note.—In some states there is a small mortgage tax, for instance in New York the tax is ½%, or $20.50 on this mortgage.

3. Appraisal fee of mortgagee	5.00

Note.—This may be included only if mortgagee has made an appraisal and it must be reasonable and in line with local practice.

4. Initial service charge at one-half per cent	20.50

Note.—An initial service charge may be made in accordance with Administration Rules and Regulations. In this case the mortgagee elects to charge one half of 1 per cent.

Total charges	59.25
Total adjustments	73.57
TOTAL..	$132.82

Purchase price	$5,400.00
Less amount of loan	4,100.00

Down payment	$1,300.00
Adjustments and charges ...	132.82
TO BE COLLECTED........	$1,432.82

Note.—Accrued taxes, assessments, fire and other hazard insurance were adjusted between buyer and seller.

TABLES FOR DETERMINING THE MATURITY DATE

Note that some of the maturity dates in the tables below are shown in *italic,* others in CAPITAL LETTERS. Where the maturity date is in CAPITAL LETTERS, the year of maturity is determined by adding the years of the amortization period to the year of first payment (add 20 in the case of a 19 years 6 months period). Where the maturity date is in *italic,* add one less than the number of years of the amortization period (add 19 in the case of a 19 years 6 months period).

TABLE I

For Full-Year Amortization Period

First Payment (Day of year)		Maturity (Day of year)	
JANUARY	1st	*December*	1st
FEBRUARY	"	JANUARY	"
MARCH	"	FEBRUARY	"
APRIL	"	MARCH	"
MAY	"	APRIL	"
JUNE	"	MAY	"
JULY	"	JUNE	"
AUGUST	"	JULY	"
SEPTEMBER	"	AUGUST	"
OCTOBER	"	SEPTEMBER	"
NOVEMBER	"	OCTOBER	"
DECEMBER	"	NOVEMBER	"

Example 1.—First payment June 1, 1936, the maturity date for an 18-year amortization period is May 1, 1954, i. e., 1936 plus 18.

Example 2.—First payment January 1, 1936, the maturity date is December 1, 1953, i. e., 1936 plus 18 minus 1. (The maturity month in this case is shown in *italic,* therefore, subtract 1 from the amortization period.)

TABLE II

Only for 19 Years 6 Months Amortization Period

First Payment (Day of year)		Maturity (Day of year)	
JANUARY	1st	*June*	1st
FEBRUARY	"	*July*	"
MARCH	"	*August*	"
APRIL	"	*September*	"
MAY	"	*October*	"
JUNE	"	*November*	"
JULY	"	*December*	"
AUGUST	"	JANUARY	"
SEPTEMBER	"	FEBRUARY	"
OCTOBER	"	MARCH	"
NOVEMBER	"	APRIL	"
DECEMBER	"	MAY	"

Example 1.—First payment November 1, 1936, the maturity month is, therefore, April. This is shown in CAPITAL LETTERS; the maturity year is, therefore, 1936 plus 20 or 1956 and the maturity date is April 1, 1956.

Example 2.—First payment June 1, 1936, the maturity month is November. This is shown in *italic,* therefore, the maturity year is 1936 plus 19 or 1955, and the maturity date is November 1, 1955.

AMORTIZATION FACTOR AND SERVICE CHARGE TABLES

FEDERAL HOUSING ADMINISTRATION

Amortization Period		Mortgage Rate of Interest—4%		Mortgage Rate of Interest—4½%		Mortgage Rate of Interest—5%	
		Monthly Amortization Factor*	Monthly Service Charge Factor 0.5%	Monthly Amortization Factor*	Monthly Service Charge Factor 0.5%	Monthly Amortization Factor*	Monthly Service Charge Factor 0.5%
Number of Years	Number of Months	Per $1,000 of mortgage principal	Per $1,000 of mortgage principal for first year	Per $1,000 of mortgage principal	Per $1,000 of mortgage principal for first year	Per $1,000 of mortgage principal	Per $1,000 of mortgage principal for first year
20	240	$6.06	$0.41	$6.33	$0.41	$6.60	$0.41
19½	234	6.17	0.41	6.43	0.41	6.70	0.41
19	228	6.27	0.41	6.54	0.41	6.81	0.41
18	216	6.51	0.41	6.77	0.41	7.04	0.41
17	204	6.77	0.41	7.03	0.41	7.29	0.41
16	192	7.06	0.41	7.32	0.41	7.58	0.41
15	180	7.40	0.41	7.65	0.41	7.91	0.41
14	168	7.79	0.41	8.04	0.41	8.29	0.41
13	156	8.24	0.41	8.48	0.41	8.74	0.41
12	144	8.76	0.40	9.01	0.40	9.25	0.40
11	132	9.38	0.40	9.62	0.40	9.87	0.40
10	120	10.13	0.40	10.37	0.40	10.61	0.40
9	108	11.05	0.40	11.28	0.40	11.52	0.40
8	96	12.19	0.40	12.43	0.40	12.66	0.40
7	84	13.67	0.39	13.91	0.39	14.14	0.39
6	72	15.65	0.39	15.88	0.39	16.11	0.39
5	60	18.42	0.38	18.65	0.38	18.88	0.38
4	48	22.58	0.37	22.81	0.37	23.03	0.37
3	36	29.53	0.36	29.75	0.36	29.98	0.36

*Monthly installment (interest and payment to principal) necessary to amortize completely mortgage principal in the stipulated amortization period.

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